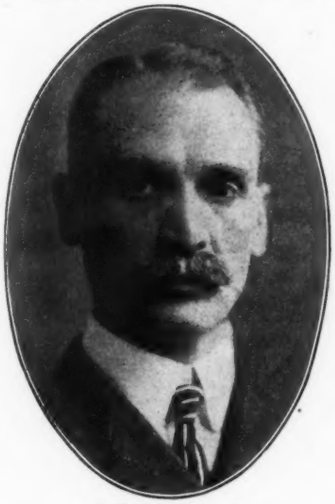
in the case of certain azo dyes as pointed out by the Tariff Commission, the last step in the combination of the intermediates to form the dye was simple and inexpensive, and that furthermore the duty on the intermediates was enough lower than that on the finished dye to make it more economical to import the former and carry on this last step in this country. It will thus be seen that dyes made in this way, although nominally American made were practically of German manufacture. The factories in which these were made



J. F. Schoellkopf

Formerly of the Schoellkopf Aniline & Chemical Works and First President of the National Aniline & Chemical Co., Inc.

could be considered little more than assembling plants.

German Domination

Nor was this German control limited to dyestuffs. A review of the industry as applied to textiles must naturally emphasize the dyestuff end. Nevertheless foreign domination was evident in many branches of chemical manufacture. For example, the production of certain important medicinals was limited to German sources. Then again, America was dependent upon that country for its chemical glassware which plays such an important part in research work. Many other similar instances could be cited.

The effect of this complete domination, as concerns dyestuffs, was far-reaching. Government investigation has shown that German chemical interests in this country formed the center of a well developed system of espionage. This phase of the situation, and the close relation of these industries to our program of national safety, constitute the most vital consideration of the question. Of more, personal interest however, in an article in a textile publication is the effect on the actual supply of dyestuffs for the mills. The German firms were able to indulge in many practices which, to say the least, were extremely uncomfortable for dye consumers. There was for example their policy of "full line forcing," which is sufficiently well-known to require no explanation.

But the point which requires greatest emphasis is the fact that bad as were conditions then, worse ones were in store for us, and would have been realized, had not the war intervened. The German dyestuff industry was in the hands of six great firms. Their policy was sufficiently unified and they were closely enough related by the system of Government subsidies to enable them to present a fairly solid stand. Nevertheless there was still a strong spirit of competition between them which helped to maintain a certain degree of control over dyestuff selling prices. Shortly before the war, however, these six great firms combined in a far greater Cartel. Here was the real menace. This organization, backed by the power and the money of the German Government could in time have exacted any terms from the nations and the industries dependent upon it for its products. The American textile industry has never felt the full effect of this Cartel. The outbreak of the European War, with the resultant cessation of trade between Germany and this country, prevented the full realization of its possibilities. The German Cartel is still in existence.

Briefly, this is the status of the American dyestuff industry before the war. It was bad enough—but potentially worse. In spite of the fact that the shutting off of German dyes was regarded as a calamity by consumers, it has proved to be a blessing in disguise. Just how complete a blessing it was will be shown in the following pages.

A discussion of American pre-war dyes cannot be closed, however, without the payment of a tribute to those few American dyestuff manufacturers who strove against overwhelming odds to establish an industry in this country. One firm should especially be mentioned, namely, the Schoellkopf, Hartford & Hanna Co., which later became one of the component parts of the merger which resulted in the National Aniline & Chemical Company, Inc. The Schoellkopf Company fought a game fight but the cards were stacked against it. In the same way the Benzol Products Co., which combined certain interests of the General Chemical Company, the Barrett Company, and the Semet-Solvay Company, tried to establish the manufacture of particular intermediates and did in fact succeed to a certain degree. However, the tactics employed by German interests to beat down this competition were almost ruinous. The story of the price slashing which was conducted in aniline oil with the intention of stifling American manufacturers has been publicly disclosed, and furnishes one of the reasons for the general hatred of German methods which still persists.

Americans admire a fighter who hangs on in the face of long odds, and accordingly those pioneer dyestuff manufacturers have gained a permanent place in national regard.

Effect of Outbreak of European War

AMONG the many and varied effects of the outbreak of the European war on American industry, none was more spectacular than that upon the dyestuff consuming trade. Previous to that time the question of the supply of coal-tar products was one which interested only a limited number of people, namely those who were directly connected with industries which consumed these products. Even in these cases, the problem of supply was relatively unimportant. Their needs were entirely cared for by the representatives of the German manufacturers. The question of price was a secondary one as the proportion of the cost of the dyestuff to the finished material was relatively small. Although it was generally known that this country was in a large way dependent upon a foreign source for these important products, this fact did not seem to arouse any serious concern among textile manufacturers.

In view of this fact, the awakening to the seriousness of the situation was all the more abrupt. The news of all Europe in flames of war was of course so startling that at first only the larger aspects of the mammoth conflict impressed themselves upon the American mind. It was not long, however, before users of dyestuffs were brought face to face with the fact that their sources of supplies of these products were imperiled. A period of the wildest speculation ensued.

Attempts to Secure Dyes

Shipments of dyestuffs from Germany were not immediately cut off. During the first six months of the war, there were many and varied attempts to secure supplies from this source. The history of these attempts is well known to all dye users. The chief means adopted was the carrying of these products in Dutch boats with the return of cotton in the same bottoms to Germany. This method was halted by the tightening of the British blockade in March, 1915, by which the shipment of cotton to Germany was prevented. The German Government refused to allow the exportation of dyes without the return of the cotton cargo and thus the most serious phase of the shortage began at that time. Before this stage was reached, however, there were other expediencies adopted, such as the chartering of ships by textile manufacturing interests and the sailing of these under the American flag to Rotterdam for the purpose of bringing back dyestuffs.

Period of Speculation

It can be realized that such supplies of dyestuffs as were held by importers and dealers in this country at the outbreak of the war, were immediately enhanced in value to a tremendous degree. There was a wild rush to stack up on these materials and prices advanced with an alarming rapidity. It is difficult to name an average percentage increase. Textile manufacturers will probably never forget the fabulous quotations attached to dyestuff samples which they received. The original type dye was diluted to the nth degree and on this poor apology for a color was named a figure many times that of the pre-war price. For example, samples were received containing as low as three or four per cent of actual coloring matter and the remainder of salt. This may have been a direct cotton dye, costing before the war about twenty or thirty cents for the full strength material, but now priced at $5.00 or $6.00 for the diluted article. Samples were received which had hardly sufficient actual coloring properties to stain a swatch of cloth in the dye test. Nevertheless, so urgent was the need that practically all colors, regardless of strength or of cost, were snatched up by the users. This is not a criticism of the action of dealers in this respect. The result was a most natural one and was to be expected under the circumstances. It is too much to ask of human nature to expect a holder of a commodity which suddenly takes on a fictitious value to refrain from getting as much for his stocks as the market will stand. Fortunes were made by such fortunate speculators.

It was, of course, impossible for these limited supplies to be stretched out to cover the country's needs for any prolonged period. Even the receipt of additional dyestuffs from China and other foreign countries failed to fill the bill. These foreign shipments were, of course, supplies of German colors which had been purchased by firms in those countries and which were bought up by wide-awake American interests and sold at the prevailing high levels.

The natural result was the substitution of other methods of dyeing. Natural dyes came into very great demand and imports of these were increased. Long forgotten methods of utilizing these dyewoods were revived. An instance of this which may be mentioned was the dyeing of logwood blues on cotton. These were far from satisfactory as dyed in most textile plants in view of the fact that oxidation ensued and blues generally became blacks in the course of time. Nevertheless dyewoods saved the day in a large measure and earned a permanent popularity so far as many uses are concerned. Mineral dyestuffs were also used wherever at all possible, and furthermore the use of dyestuffs was cut down by the adoption of light shades instead of heavy shades and the popularizing of far smaller designs in print cloths. Indigo was about the only color which continued to be imported in amounts anywhere near pre-war figures. China, Japan, British India and Great Britain supplied quantities of this important dye to the United States, so that during the fiscal year ending June 30th, 1916, imports of indigo were about 80 per cent of our normal consumption. The price, however, was four times the pre-war quotation.

One of the interesting developments

William H. Nichols

Chairman of the Board of the General Chemical Co.

in connection with the importation of dyestuffs during this critical period was the arrival of the submarine "Deutschland" from Germany in July, 1916, with about 400 tons of dyes. The arrival was in the nature of a surprise and it was predicted that regular trips would be made in the future. However, after one more trip in October of the same year this source ended.

Effect on Mill

Although many textile mills were threatened with the necessity of closing down, owing to scarcity of immediate

dyestuffs, this danger did not materialize to a serious degree. Manufacturers managed to worry along by the use of substitutes mentioned above, and by the strictest economy in the consumption of supplies on hand. The hopes of the consuming industries were pinned on the prospects of American manufacture.

Beginnings of American Production

OF far greater significance than the use of substitutes and the economy of existing supplies was the problem of the creation of an American dye manufacturing industry which would gradually supply domestic needs. Strange as it may seem there was far from a unanimity of opinion that such development could be achieved. The problem was investigated by many individuals and organizations and the obstacles in the way of the establishment of a self-contained American industry appeared almost insurmountable. The fact that a number of dyestuffs had been manufactured by a few domestic firms was minimized by the consideration that a great proportion of their materials of manufacture had been secured from Germany. The manufacture of even the simplest dyestuffs called for such a large number of preliminary steps, the construction of such an amount of special machinery, and the training of a specialized personnel that capital naturally hesitated before investing in such an undertaking. Furthermore, there was still the impression that the European war could not be of very great duration and the futility of creating in a short space of time an industry which could compete with Germany's remarkable machine, once she was in a position to resume her position, appealed very strongly to hard-headed business men.

In addition to the above handicaps, there was the uncertainty as to the degree of Governmental protection of which dye manufacturers could be assured. It was not until the end of 1915 that a bill was introduced into Congress providing for increased duties on dyestuffs and intermediates. This was the Hill Bill. Hearings were heard in the early part of 1916, but it was not until September of the latter year that an Act was passed. A more detailed consideration of this phase of the problem will be taken up in this issue in a consideration of the legislative aspects of the dye question.

Early Attempts

In view of these many obstacles, it can be realized that the actual manufacture of dyes in this country did not immediately get into full swing. The year 1915 was consequently devoid of any great progress in domestic manufacture. This was the period of hopeful anticipation for the end of the war and of unceasing attempts on the part of far-sighted chemists and others to arouse the country in general and industry in particular to foster in every way the growth of the American dye industry. The struggle was a hard one. A further report issued by Dr. Thomas H. Norton during the course of that year, showed that there were twelve manufacturers of artificial dyestuffs in this country. These comprised the following, as noted in the annual issue of TEXTILE WORLD, published Jan 15, 1916:

Schoellkopf Aniline & Chemical Works (Inc.), Buffalo, N. Y.
W. Beeker's Aniline & Chemical Works, 105 Underhill avenue, Brooklyn, N. Y.
Heller & Merz, Newark, N. J.
The Central Dyestuff Co., Newark, N. J.
The Consolidated Color & Chemical Co., Newark, N. J.
The Bayer Co. (Inc.), Rensselaer, N. Y.
The Pearsite Co., Clay City, Ky.
The Federal Dyestuff & Chemical Co., Kingsport, Tenn.
A. Klipstein & Co., West Charleston, W. Va.
The Dow Chemical Co., Midland, Mich.
The American Co-operative Dyes & Chemical Co., 848 Drexel Building, Philadelphia, Pa.
The United Securities Dye and Chemical Co., Wilmington, Del.

The same report showed that there were five firms manufacturing coal-tar crude and seventeen firms manufacturing coal-tar intermediates. During the first year of war conditions, domestic output of coal-tar dyes had doubled. As far as the crudes are concerned, the following is the approximate monthly output at the end of 1915: Benzol 7,500 tons, toluol 7,870 tons, xylol 950 tons, naphthalene 12,500 tons, phenol 10,000 tons. This supply of crudes however, could not by any means go entirely into the manufacture of dyestuff intermediates, owing to the demand of these products for explosives. Nevertheless the production of intermediates had increased considerably, especially of aniline.

It will thus be seen that despite the natural hesitation about investing capital in dye manufacture and the uncertainty as to the possibility of establishing a permanent industry in this country, the first year showed appreciable gains. By the end of that period, it had generally been realized that the European war was to be a long drawn out affair and that even should it suddenly stop, there would be a period of reconstruction necessary before Germany could resume her position as the dyestuff center of the world. Far more important, however, was the apparent gradual arousing of a public sentiment in favor of the fostering of an American industry. The feeling of national disgrace that our manufacturers should be hopelessly at the power of another country, so far as the supplying of their raw materials were concerned, began to play a vital part in stimulating American production.

INDUSTRIES DIRECTLY DEPENDENT ON DYESTUFFS.*

Industry	Number of establishments.	Number of people employed.	Capital invested.	Value of products.
Dyeing and finishing textiles	507	48,467	$139,194,000	$109,292,000
Cotton textiles	1,287	385,964	678,809,000	868,094,000
Hosiery and knit goods	1,622	150,520	215,826,000	258,913,000
Silk goods	902	108,170	210,072,000	254,011,000
Woolen and worsted goods	799	158,692	399,653,000	379,484,000
Felt goods and wool felt hats	83	5,284	22,893,000	15,638,000
Carpets and rugs	97	31,209	85,154,000	69,128,000
Shoddy	64	2,145	6,421,000	7,707,000
Linen goods	21	3,567	8,810,000	6,960,000
Mats and matting	12	869	3,055,000	2,236,000
Fur felt hats	224	21,318	39,401,000	37,350,000
Leather industry	741	55,936	332,180,000	367,202,000
Paint and varnish industry	800	16,083	129,534,000	145,624,000
Printing inks	70	1,391	11,943,000	13,830,000
Paper industry (paper alone)	495	42,481	177,413,000	158,427,000
Blacking, stains, etc.	197	1,766	4,986,000	9,882,000
Blueing	66	254	712,000	1,184,000
Perfumery and cosmetics	496	2,897	9,647,000	16,899,000
Inks, writing	54	512	2,464,000	2,784,000
Artificial flowers	217	4,808	3,349,000	7,614,000
Buttons	517	14,511	19,075,000	20,712,000
Feathers and plumes	239	4,483	5,396,000	11,451,000
Fur goods	1,322	9,030	29,677,000	43,633,000
Hair work	205	1,193	2,543,000	3,335,000
Total	11,037	1,070,460	$2,530,207,000	$2,631,390,000

* Included in statement by Dr. J. Merritt Matthews at hearings on dye bill before House Committee on Ways and Means. Compiled from U. S. Census of Manufactures, 1914.

American Dyestuff Industry in 1916

THE year 1916 must be regarded as a period of greatest development in connection with the new industry. During these twelve months, domestic production gained an impetus which has carried it successfully to its present remarkable status. In a census issued by Dr. Thomas H. Norton of the Department of Commerce in October of that year, it was shown that there were thirty-six firms in America manufacturing coal-tar dyes; forty firms manufacturing intermediates; eighteen firms producing crudes and fifteen firms manufacturing vegetable dyestuffs. The following firms were manufacturing dyestuffs at the time of that report:

Agawan Chemical Works, Providence, R. I.
Amalgamated Dyestuff & Chemical Works, Newark, N. J.
American Aniline Products, Inc., Harrison, N. J.
American Dye Company, Chicago, Ill.
American Synthetic Dyes, Inc., New York.
Ault & Wiborg, Cincinnati, Ohio.
The Bayer Company, Inc., Rensselaer, N. Y.
W. Beckers Aniline & Chemical Works, Brooklyn, N. Y.
Calco Chemical Company, Bound Brook, N. J.
Central Dyestuff Company, Newark, N. J.
The Chemical Company of America, New York.
Consolidated Color & Chemical Company, Newark, N. J.
Dow Chemical Company, Midland, Mich.
Dye Products Company, Manayunk, Pa.
E. C. Klipstein & Sons, Chrome, N. J.
Ernst Zobel Company, Brooklyn, N. Y.
Federal Dyestuff & Chemical Company, Kingsport, Tenn.
Franco-Swiss Dyes, Inc., New York.
Frank L. May & Co., Perth Amboy, N. J.
F. A. McJuncth, Milwaukee, Wis.
Heller & Merz, Newark, N. J.
H. M. T. Co., St. Louis, Mo.
Holland Aniline Company, Chicago, Ill.
Hub Chemical Company, South Boston, Mass.
Marden, Orth & Hastings Company, New York.
Neidich Process Company, Burlington, N. J.
Neversink Company, Reading, Pa.
Reading Chemical Manufacturing Company, Reading, Pa.
Semet-Solvay Company, Syracuse, N. Y.
Sherwin-Williams Company, Pullman, Ill.
Schoellkopf Aniline & Chemical Works, Inc., Buffalo, N. Y.
Standard Aniline Products, Wappingers Falls, N. Y.
Stanley Aniline Chemical Works, Lock Haven, Pa.
United States Aniline & Chemical Company, St. Louis, Mo.
United States Coal-Tar Products Company, Inc., New York.
Verona Chemical Company, Newark, N. J.

Another important development of the year was the announcement of the E. I. Dupont de Nemours & Co., Wilmington, Del., that they intended to turn their auxiliary munition factories into dyestuff plants after the war. They were at that time important manufacturers of intermediates and this announcement of the future extension of their field was received with great interest by the entire consuming industry.

False Rumors Circulated

An unfortunate but most natural condition that featured those early days of dyestuff manufacture, was the spreading of countless false rumors regarding fancied discoveries of great value in connection with the manufacture of dyes. Occupying as it did such an important part in the news of the day, dyestuff production became a fertile field for the work of inexperienced inventors and scare-story writers. Few weeks passed by which did not witness the announcement of a discovery which was to revolutionize the entire method of making dyes. The statement that a learned scientist had found a new way of manufacturing synthetic dyestuffs was always sure of a gullible audience. The reason for the credulity of the public was the fact that even then, so little actual fact was really known by the layman regarding the intricate chain of processes involved in the manufacture of any one dyestuff. Otherwise it would have been realized that it would be just as foolish for a man to say that he had discovered a new way of making a steam engine as a new method of manufacturing dyestuffs. Meaningless generalities were indulged in, and dyestuff news was highly colored with fiction. This period passed however, and in the meantime the actual manufacturers were devoting all their energies towards attempting to supply the needs of the textile mills.

Emphasis on Azo Dye

It has been repeatedly stated that American dye manufacturers followed the lines of least resistance. This is at the best a half truth, for it implies that they dodged the difficult tasks and engaged only in the manufacture of those products which were simple to produce and which offered a satisfying return. As a matter of fact, the domestic manufacturers did the only thing which they could have done, either from their own standpoint or from the standpoint of the consumers. The crying need at that time was for sufficient quantities of dyestuffs to keep the mills running. If the manufacturers had failed to meet this need, and had devoted their time and resources to prolonged research work on the production of fast dyes, the textile industry would have been the sufferer.

Before the war such American development as had occurred was confined to a group of dyes called azo dyes. It was natural that advantage should have been taken of such progress as had been made along these lines and it was accordingly in this direction that emphasis was placed. Fast dyes depending upon anthracene were not produced. Nevertheless it must be stated here and this fact should be emphasized even today, that type for type, the American products were soon developed to a degree of perfection which made them equal to their German prototypes. Comparisons are odious, only if based upon a false premise, and certainly there could be no more mistaken comparison than that between German and American dyes as a general class. For a while it was popular to remark: "Oh,

that color isn't fast, it was made in America", whereas nine times out of ten, if the shade had been compared with that produced from the particular German dye used for that purpose, the American product would have been found to be fully as good.

One reason for the slurs cast on dyes of domestic manufacture in the early days of production was the fact that mills were forced in many cases, owing to gaps in the American line, to use certain dyestuffs for purposes for which they were not really intended. It can be realized that such practice would unjustly disparage American-made dyestuffs.

It was in 1916 that the tariff act based on the Hill Bill was passed. On Sept. 8, 1916, Congress put through the new measure placing crudes on the free list, and imposing on intermediates a duty of 15 per cent plus 2½ cents per pound and on dyes and other finished products a duty of 30 per cent plus 5 cents per pound. This was the first assurance of Government protection, and although the tariffs mentioned are now believed to be inadequate for the future, the passage of the act greatly encouraged further efforts on the part of the dyestuff manufacturers.

American Dyestuff Industry in 1917

STATISTICS are usually dull, but sometimes they tell a story which is romantic in the extreme. Such an industrial romance is contained in the figures showing the production of coal-tar dyes in 1917, as compared with the annual importation before the war. According to figures compiled, the production in the United States during 1917 amounted to 45,977,246 pounds, while the imports for the fiscal year, 1914, amounted to 45,840,866 pounds. It will thus be seen that so far as tonnage is concerned, the American industry had come into its own. There were, however, important gaps still in the line of domestic dyestuffs notably in indigo and in the alizarine and vat dyes. Indigo was being produced, but not nearly in the amounts needed for consumption. However, in the year 1917, the acute scarcity of coloring matters was eliminated and although mills were forced to do without certain colors which they had used before the war, the danger of shut-downs in the consuming industries owing to lack of dyestuffs was entirely wiped out.

This, then, was the main contribution of the year under consideration. That it was no small one will be appreciated when it is recalled that it was only three years ago that the continued operation of the vast textile mills of the country was imperilled by the abrupt cutting off of their source of dyestuff supply.

Other far-reaching developments featured the year 1917. One of these was the tendency towards amalgamation of existing manufacturing companies. This was the most natural and healthy trend in view of the fact that the American manufacturers had to look forward to competing with a gigantic combination of German firms. Nevertheless, amalgamation of American firms did not and never has to this day, even approached monopoly. New firms continually sprang up and a healthy spirit of competition has been maintained. The most notable instance of combination in 1917 was the merger of the National Aniline & Chemical Company and the W. Becker Aniline & Chemical Works with the inclusion of a working arrangement with the General Chemical Company, the Semet-Solvay Company and the Barrett Company, by which important intermediates and chemicals were supplied. The new company was called the National Aniline & Chemical Co., Inc.

More Capital Invested

Still another development of the year was the entrance of large capital into dyestuff manufacture. An approximate estimate revealed the fact that in that year $146,160,000 new capital became interested in this industry as compared with $90,244,000 in 1916; $65,565,000 in 1915; and $16,838,000 during the five months of 1914. This made a total of $327,807,000 invested from the beginning of the war to the end of 1917. These figures are important because one of the chief handicaps in the early days of dye production in this country, had been the hesitancy on the part of capital to invest in an industry whose future was so dependent upon legislative whims as was the dye industry.

There are still other statistics regarding the domestic industry in 1917 which redeem their dullness by telling a story of a remarkable achievement. Government figures place the number of firms engaged in the manufacture of coal-tar chemicals, during that year at 190. These firms employed 1,733 chemists and other technically trained men and 17,910 others, not technically trained. Over $250,000,000 was spent during the year in research work alone.

Of these 190 firms, 81 were engaged in the manufacture of coal-tar dyestuffs. The following is a list of new additions to the ranks as compiled by the Bureau of Foreign and Domestic Commerce:

H. R. Ackerman Co., New York.
Acme Dyestuff & Chemical Co., Metuchen, N. J.
Alliance Chemical Co., Boston.
Althouse Chemical Co., Reading, Pa.
American Color Mfg. Co., New York.
Atlantic Dyestuff Co., Boston.
Beaverkill Dye Works, Cooks Falls, N. Y.
Bick & Undy, Philadelphia.
Binney & Smith Co., New York.
Block Chemical Co., New York.
Brunswick Chemical Co., Newark, N. J.
Butler Chemical Co., New York.
California Aniline & Chemical Co., West Berkeley, Cal.
Camden Chemical Co., New York.
Catalytic Chemical Co., West Berkeley, Cal.
Chemical Manufacturing Co., New York.
Chrome Color Works, Mattawan, N. J.
Commonwealth Color & Chemical Co., Brooklyn, N. Y.
Connecticut Color Co., Danielson, Conn.
Continental Chemical Co., St. Louis, Mo.
Cosmic Aniline Works, New York.
Drug & Dyestuff Corporation, New York.
Dye Products & Chemical Co., Inc., New York.
Eagle Color & Chemical Co., New York.
Fleming Chemical Co., Cleveland, O.
Fulmer & Apeldorn, Philadelphia.
Haack & Co., Newark, N. J.
Hellenic Chemical & Color Co., Inc., New York.
Hoffman & Kropf Chemical Co., Brooklyn, N. Y.
Holland Aniline Co., Holland, Mich.
Holiday-Kemp Co., Inc., New York.
Hord Color Products Co., Sandusky, O.
Independence Aniline & Refining Co., Independence, Mo.
Independent Chemical Co., New York.
International Color & Chemical Co., Detroit, Mich.
Iridescent Dyestuff & Chemical Co., Brooklyn, N. Y.
Jacksonville Chemical Manufacturing Co., Jacksonvile, Fla.
Louis Jaeck Co., New York.
Keystone Dyestuff & Chemical Co., Newark, N. J.
L. & R. Organic Products Co., Inc., New York.
Lansing Chemical Co., Lansing, Mich.
Mackey Wood Aniline Co., Inc., Haledon, N. J.
Melrose Chemical Co., Melrose, Mass.
Merck & Co., New York.
Monroe Color & Chemical Co., Quincy, Ill.
Mont Color & Chemical Co. (Swift Chemical Co.), New York.
New York Color & Chemical Co., New York.
Organic Products Corporation, Schenectady, N. Y.
Peerless Color Co., Bound Brook, N. J.
Pennsylvania Color Manufacturing Co., Philadelphia.
Perolin Co. of America, New York.
Philadelphia Aniline & Extract Co., Philadelphia.
Reliance Aniline & Chemical Co., New York.
Saxe Chemical Co., New York.
Geo. H. Segal & Co., New York.
Simeon & Elting, New York.
Standard Color Works, New York.
Synthetic Products Co., Inc., North Tonawanda, N. Y.
Transatlantic Chemical Corporation, New York.
West Coast Chemical Co., Seattle, Wash.
Westover Chemical Co., Pennington, N. J.

INDUSTRIES INDIRECTLY DEPENDENT ON DYESTUFFS.*

Industry.	Number of establishments.	Number of people employed.	Capital invested.	Value of products.
Clothing, men's	4,830	183,747	$224,051,000	$458,211,000
Shirts	792	51,972	50,944,000	95,815,000
Suspenders, garters, etc.	216	9,646	16,344,000	24,433,000
Hats and caps	580	7,322	6,847,000	18,593,000
Clothing, women's	5,564	168,907	153,549,000	473,888,000
Millinery	2,079	45,274	53,101,000	114,160,000
Awnings, etc.	888	5,073	9,958,000	18,138,000
Horse clothing	37	1,669	4,482,000	5,150,000
Flags and banners	87	1,495	1,843,000	3,601,000
Regalia and badges, etc.	138	2,010	4,122,000	5,025,000
Oilcloth and linoleum	31	5,651	28,041,000	25,598,000
Imitation leather	10	795	6,020,000	6,097,000
Finished products of leather	6,017	251,124	411,167,000	737,393,000
Manufactures of paper	1,711	74,630	138,888,000	174,681,000
Printing and publishing	33,471	272,092	720,232,000	901,534,000
Hat and cap materials	98	1,775	6,417,000	6,929,000
Total	56,549	1,073,182	$1,836,006,000	$3,069,246,000
Directly dependent	11,037	1,070,460	2,530,207,000	2,631,390,000
Grand total	67,585	2,143,642	$4,366,213,000	$5,700,636,000

* Included in statement by Dr. J. Merritt Matthews at hearings on dye bill before House Committee on Ways and Means. Compiled from U. S. Census of Manufactures, 1914.

Progress in Intermediates

Of vital significance in the growth of the dyestuff industry in 1917 was the progress made in developing the necessary intermediates upon which the various dyes depend. Both the number of companies concerned and the variety of their products increased to a remarkable degree. There were 118 companies which reported to the Tariff Commission that they were manufacturing intermediates during that year. Distinct materials of this group numbered 134 with a total weight of 322,745,858 pounds, valued at $106,960,750. Among the important intermediates which showed greatly increased output were phenol, aniline, oil, and monochlorbenzol. There also appeared on the market in considerable amounts beta napthol, H acid and other naphthalene derivatives. Unfortunately there was still an absence of anthraquinone and other anthracene derivatives.

Effect of War

In recording the development of the dye industry in America during 1917 it must not be overlooked that this was the year of the entrance of the United States into the world war. This event produced radical differences in the operation of the textile mills which were of course reflected in dyestuff manufacture. There was an immediate demand for military cloths which naturally called for dyestuffs of a particular class to meet this need. As a result, the dye manufacturing firms were forced to concentrate to a large degree on this branch of the business and to forego research and development work along other lines. This feature continued, of course, during the year and a half of America's participation in the war and its reaction upon the dyestuff industry must not be overlooked in considering the progress made during the five short years of its existence.

Still another and equally important effect of the entrance of the United States into the war, was the heavy demand for many raw materials, used in dye manufacture, for the output of explosives and other military requirements. Many of these materials were commandeered and this resulted in an acute shortage for dye making purposes. As an example, toluol which is the material used in making dyestuffs, was practically entirely taken over for military requirements and only small amounts released for the manufacture of dyes producing khaki shades.

Despite these handicaps, the year 1917 was remarkable for the progress made both in increasing the output and developing new dyestuffs.

American Dyestuff Industry in 1918

THE most encouraging fact to be drawn from a consideration of the development made in dyestuff manufacture in the United States in the year 1918, was the appearance on the market of many dyestuffs which were not available during the preceding year. In that year over 300 different dyes were made in this country. Furthermore, the output showed a very satisfactory increase. The output of dyestuffs in 1918 was 58,464,446 pounds valued at $62,026,390 as compared with 45,977,246 pounds in 1917 valued at $57,796,228.

It must not be assumed, however, that the production of American plants was sufficiently comprehensive to include all the needed classes of dyestuffs. There were still serious gaps in the domestic lines which handicapped the consuming industries and which caused textile mills to have recourse to the use of substitutes. Real progress was made in the development of the azo dyes and with a few exceptions, most of the important colors of this nature were available. Among the gaps in this particular line, the Tariff Commission in its report for the year, pointed out especially Zambesi black, used for black dyeing of hosiery, composed of cotton and silk mixed. Nevertheless, it can safely be stated that the American manufacture of azo dyestuffs came pretty close to satisfying domestic needs for those particular products. During 1918, there were 24,931,556 pounds of these dyes produced, valued at $32,039,232.

Sulphur dyes were also developed to a satisfying degree and sold at prices which were comparatively reasonable. Certain of these dyestuffs were in considerable demand for the dyeing of

military material. Sulphur colors to the total of 23,698,826 pounds valued at $10,812,686 were produced during that year.

Progress was also made in the production of induline dyes of which the most important member is nigrosine.

Regarding the important class of triphenylmethane dyes which are in wide demand owing to their brilliancy of shade, a considerable amount of success was attained by the domestic industry, although certain important members were missing. Rhodamine B was produced for the first time in 1918 and then in only limited amounts so that the price remained exceedingly high.

Coming to the fast dyestuffs, the greatest progress recorded was in indigo. Three firms produced 3,083,888 pounds in 1918. This amount may seem small when it is recalled that in 1914 8,507,359 pounds were imported into this country. On the other hand it looms large when compared with the production of 1917 which totalled only 277,771 pounds which was made by only one firm. Other dyes of the indigo class were practically unavailable to any degree.

In 1918, progress was made in developing alizarine and two derivatives of this product, but not in amounts sufficient to meet the demand. Research work was done on vat dyes produced from anthracene but the commercial production was negligible.

Intermediates

Whereas in 1917 there were 134 intermediates produced with a total weight of 322,745,058 pounds, valued at $106,966,750, there were, in 1918, 177 intermediates produced with a gross weight of 357,662,251 pounds valued at $124,382,892. These figures show real progress made during 1918 and the development is especially noteworthy in view of the fact that the entire year was a war year, and that the restrictions previously mentioned continued in force. Of special significance was the production of six intermediates derived from anthracene including anthraquinone.

Among the intermediates which showed a considerable increase in output in 1918 as compared with 1917, were dimethylaniline salicylic acid, beta naphthol and benzidine. There was a decline in the production of aniline oil, monochlorbenzol and H. Acid.

Licensing of Patents

The handicaps imposed by war conditions as affecting the dyestuff industry have already been mentioned. There was, however, one important benefit and that was the authority given under the Trading with the Enemy Act for the licensing of enemy patents to American manufacturers. This inaugurated important research work on many dyes not heretofore made in this country. While this was not productive of immediate results, it promised well for the future.

Furthermore, the end of the period of acute scarcity, with its accompanying call for immediate delivery of dyestuffs, gave the manufacturers of these products, more time to develop their processes, to improve the uniformity of their colors, and to reduce the manufacturing costs and consequently the selling price. All of these results reacted favorably upon the American industry.

List of Manufacturers

The last official list of manufacturers of coal-tar products was contained in the Census of Dyes and Coal-tar Chemicals, 1918. This list, of course, is not entirely accurate at the present time as many names have been added and others dropped. It showed a total of 187 firms exclusive of coke oven plants and gas houses.

Dyestuff Development Since 1918

UNFORTUNATELY the report of the Tariff Commission on Dyes and Coal-tar Chemicals for the year 1919 has not as yet been published, and it is impossible to give official figures as to progress made since the close of 1918. Individual opinions can, of course, be obtained but as these differ widely they are not of such real value as statistics based upon the far-reaching methods of the Government body in securing statistics. Consequently anything that is said regarding the progress of the industry during the past year and a half must be taken as a consensus of opinion of the important factors in the trade.

That there has been real and satisfying development made is a matter of public record. Probably the point to be stressed the most is the active beginning of the manufacture of vat dyestuffs. The American industry has been severely criticised since the close of the war for its failure to produce these important dyes in sufficient quantities to meet the consuming needs. There has even been a tendency on the part of certain factors to claim that the industry has "lain down on the job," content with the progress made heretofore and secure in their belief in permanent Government protection. This claim is almost too ridiculous to warrant refutation. In the first place, such statements are usually made by people who have no conception of the months and even years of research and development work which are required in the production of the more intricate dyestuffs. They forget that Germany had a half century of preparation for development which they expect the American industry to achieve in five years. They forget that the manufacture of each individual dye calls for special raw materials, special equipment, and highly specialized technical knowledge. Furthermore they overlook the fact that a safety valve is provided by the clause in the act of September 8, 1916, which stated that if at the expiration of five years from the date of that act, it was found that there was not being manufactured in the United States, sixty per cent in value of the domestic consumption of the articles mentioned in groups II and III of that act, the duties imposed by the law should no longer be collected. Still another safety valve is the action of the War Trade Board Section of the Department of State in granting licenses for the importation of all dyes not made in this country in commercial quantities or at a sufficiently reasonable price. By the very nature of these restrictions, it was evidently up to the dye manufacturers to push their production as quickly and as completely as possible.

Vat Dyes Appear

It must be admitted that to a casual observer, the continued absence of vat dyestuffs from the American market for more than a year after the close

Dr. Chas. H. Herty
Sent Abroad as Special Representative to Secure Vat Dyes

of the war, was difficult to understand. Assurances by important firms that their research departments were hard at work on the development of these dyestuffs availed little in meeting the objections of the opposition. At last, however, actual announcement has been made of the production of vat dyestuffs by certain important firms. The Newport Chemical Color Works, Inc., announced in August that they had perfected three Indanthrene dyes. E. I. du Pont de Nemours & Co., have completed experimental work on eight vat dyestuffs. Dow Chemical Co. is offering certain important vat dyestuffs. Furthermore there will be, no doubt, other announcements of similar development on the part of additional firms. From now on the variety and quantity of these important products, manufactured by the American firms will no doubt, show a steady increase.

Importation of German Dyes

One of the important recent developments in the dye industry was the appointment of Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry*, to go abroad as special representative to secure German vat dyes as required by the consuming industries. Dr. Herty sailed in September, 1919, and after arranging for as large a portion as possible with the Inter-Allied Reparation Commission, secured an option on the remainder through direct negotiations with the German Cartel. The Textile Alliance, Inc., acted as the importing agency for all of the former dyestuffs and most of the latter. The great bulk of these dyes has been received.

Steady Progress

Since the close of 1918, there have not been such spectacular developments as featured the early days of the dye industry after the outbreak of the war. There has, however, been a steady and healthy development in the variety and quality of the products produced. The manufacture of indigo has taken especially great strides and although there is still a market for the imported vegetable indigo, and despite the fact that there is no surplus produced, it is safe to say that the domestic manufacture of the synthetic material is progressing most satisfactorily.

There have been further amalgamations noted in the ranks of the American manufacturers and while a certain few have been weeded out, the present time finds practically all the existing concerns on a firm, well established basis.

Price Fluctuations of Dyestuffs

THE most valuable source of information regarding price movements of dyestuffs since the outbreak of the war is the bulletin issued by the War Industries Board entitled "Prices of Coar-tar Crudes, Intermediates and Dyes." The accompanying chart which appeared in that bulletin shows the price movements of these three groups from the year 1913 to 1918, taking as a basis the average quoted prices from July 1913 to June 1914, and calling this basis 100. It will be seen from this chart that crudes reached their peak in the spring of 1916 when they averaged about four and a half times the pre-war basis. They then declined until at the end of 1918 they were very nearly back to normal. Intermediates reached their peak in the latter part of 1915 when they were approximately fourteen times their pre-war basis and declined until at the end of 1918 they were approximately four times the normal range. Dyestuffs reached their peak in the spring of 1916 when they were over nine times their pre-war basis and declined until at the end of 1918 they were somewhat over three times the normal basis.

Prices of Intermediates

Taking individual commodities into consideration, this same bulletin shows that in 1913, aniline oil was quoted at approximately 10 cents per pound, and that following the outbreak of war it steadily increased in price until it reached its maximum of $1.80 in April, 1915, declining from that time on until, at the end of 1918, it was priced at 28 cents. Beta naphthol quoted at 11 cents before the war advanced to a maximum of $1.35 in February, 1916, and declined to 60 cents at the end of 1918. Paranitraniline, quoted at 15 cents before the war, advanced to $1.50 in April, 1916.

REMEMBER

that the American dyestuff industry has developed under conditions which have been far from ideal. The all-important initial years of its growth were war years. This means that:

Labor was at a premium.

Mills were working largely on military orders which called for great amounts of dyes of a particular nature and thus inhibited the expansion of color manufacture to other classes.

Raw materials were in demand for production of military explosives.

Transportation problems were many and serious.

The building up of a new and complicated industry would be a serious task under normal conditions; in war time it became a monumental one.

and then declined somewhat, but recovered, and was quoted at $1.65 at the end of 1918.

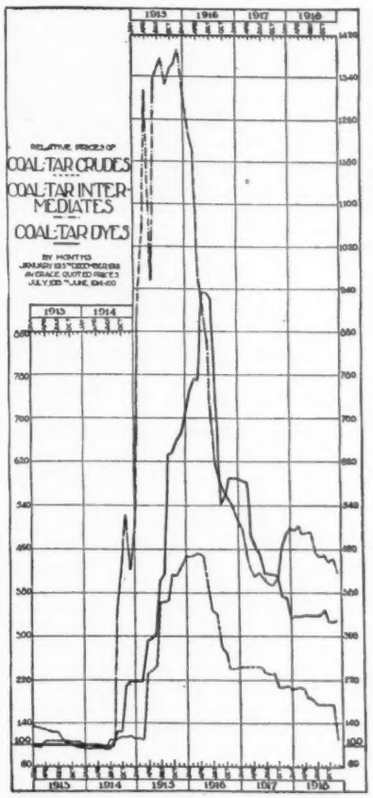
Prices of Dyestuffs

Chrysoidine Y, quoted at approximately 30 cents before the war, advanced to a maximum of $2.00 in June, 1916, and then declined until it was quoted at the end of 1918 at $1.10. Scarlet 2-R, quoted at 21 cents before the war, advanced to a maximum of $3.00, and then declined until it was quoted at 95 cents at the end of 1918. Orange II, quoted at 14 cents before the war, advanced to a maximum of $1.66, and then declined until it was quoted at 55 cents at the end of 1918. Bismarck Brown, quoted at 30 cents before the war, advanced to a maximum of $3.50, and then declined until it was quoted at $1.35 at the end of 1918. Direct Black, quoted at 32 cents before the war, advanced to a maximum of $3.50, and declined until it was quoted at 95 cents at the end of 1918. Synthetic indigo, 20 per cent. paste, quoted at 18 cents before the war, advanced to a maximum of $1.90, and declined until it was quoted at $1.15 at the end of 1918.

More Radical Advances

These figures are of vital interest as showing the general trend of prices during the war period. They do not, however, indicate the ridiculous figures to which some colors soared during the speculative period following the first evidence of shortage of dyestuffs. The extent to which existing stocks were diluted and the fictitious values placed on the weakened product put the selling price of certain dyestuffs at prices literally several hundred times their normal value.

The most encouraging conclusion to be drawn from the price fluctuations, however, is the steady decline in the last two or three years. Production methods have been improved and simplified and the consumer has benefited by the lower prices resulting. Quotations have been fairly stable during the last six months with the exception of those on certain intermediates which were forced by scarcity to new high levels last spring. Since that time they have again declined to figures more nearly approximating normal. It is generally believed in the trade that movements in the future will be gradual and that they will be in the main downward as manufacturing conditions continue to improve.



RELATIVE PRICES.—Coal-Tar Crudes; Coal-Tar Intermediates; and Coal-Tar Dyes.—By months, January, 1913, to December, 1918. (Average quoted prices, July, 1913, to June, 1914=100.)

Legislative Aspects of Dyestuff Question

A VOLUME could be written upon the legislative phases pertaining to the American dye industry. As a matter of fact two volumes *have* been written, namely, the reports of hearings before the House and Senate Committees on the so-called Longworth Bill. It is impossible in the limited space available to more than touch upon the intricacies of the legislative tangle in which dyestuffs have been involved during the past year or two. While the conflict has been unfortunate in that it has thrown a shadow of uncertainty around the future of dyestuff production in this country, nevertheless it is believed by many factors that the public education which has resulted from the open c[illegible]nsures the final adoption of a policy which will be grounded upon the understanding and support of the entire nation.

There are two distinct classes of legislation which have been considered for the proper protection of the American industry. One of these is the imposing of sufficiently effective duties upon imports, and the other is the restriction of these imports.

Tariff Question

Under the old Underwood Act, crudes were dutiable at 5 per cent; intermediates at 10 per cent, and dyes at 20 per cent. In December, 1915, a bill was introduced by Representative Hill of Connecticut, placing crudes on the free list; imposing a duty of 15 per cent plus 3¾ cents per pound upon intermediates, and a duty of 30 per cent plus 7½ cents per pound upon dyes. After much dispute, an act modeled on the Hill Bill was finally passed, placing crudes on the free list; imposing a duty of 15 per cent plus 2½ cents per pound on intermediates, and a duty of 30 per cent plus 5 cents per pound upon dyestuffs, except that the 5 cents per pound did not apply to "natural and synthetic alizarine and dyes obtained from alizarine, anthracene and carbazol; natural and synthetic indigo and all indigoids, whether or not obtained from indigo." This act was passed September 8, 1916, and these duties are at present in force.

Greater Protection Urged

That this was not sufficient protection was the belief of most factors interested in the development of the American dyestuff industry. Accordingly, in 1919, a bill was introduced by Representative Longworth, amending the act of September 8th, 1916. There immediately followed a most interesting public debate and the subject was thrashed out before the House Committee on Ways and Means. The Longworth Bill was finally passed by the House in the fall of 1918, and provided that crudes were placed on the free list, intermediates were made dutiable at 40 per cent ad valorem plus 6 cents per pound, and dyes at 45 per cent ad valorem plus 7 cents per pound, with certain restrictions which have been mentioned many times in the press.

Import License

Of far more radical importance was the provision of this bill that, for a period of five years, none of the products mentioned might be imported into the United States except under license obtained from the United States Tariff Commission. It was further provided that this body should issue licenses to import, for domestic consumption, products unobtainable from domestic sources and also such products which, although obtainable from domestic sources, were unobtainable on reasonable terms as to price, quality and delivery.

It was on this section that practically all of the debate centered. It was claimed by dye manufacturers and other interested in the development of the industry, that tariff alone would not afford sufficient protection in view of the fact that the German dyestuff trust, backed by the power of the German Government, could afford to export dyestuffs to the United States at a loss until gradually American competition would be stifled. To prevent this, the system of import licenses was proposed. On the other hand those opposed to dye licenses claimed that the elaborate procedure built up by the bill would make the importation of needed dyestuffs by consumers extremely difficult and uncertain, and that textile manufacturers would be forced to disclose many of their trade secrets in their requests for the needed dyes. The textile industry was divided on the matter, as certain groups were in favor of the adoption of dye licenses and others united in strong opposition.

After passage by the House, the bill was referred to the Senate Committee on Finance. Here again public hearings were held and finally a sub-committee of the Finance Committee reported the bill to the Senate with certain radical changes. The duty on intermediates was reduced to 15 per cent plus 6 cents per pound, and on dyes to 30 per cent plus 7 cents per pound. In place of the licensing system proposed in the House Bill, the Senate Committee recommended an embargo on the admission of dyes to this country to be administered by the Tariff Commission in accordance with certain limitations specified in the revised bill. The new bill was taken up on the floor of the Senate and certain amendments proposed. One of the important amendments was proposed by Senator Moses of New Hampshire, and inserted in lieu of the embargo provision, certain sections which had the effect of an anti-dumping plan. Further opposition developed in the Senate, and it finally became apparent that the bill could not be passed before the close of the session last spring. The bill is consequently at present in a waiting position and will be taken up when Congress convenes in the fall.

War Restrictions

Pending the end of this legislative dispute, American dye manufacturers have been effectively protected by the functions of the War Trade Section of the Department of State, which has not permitted the entrance of dyestuffs unless not made here in sufficient quantities and at reasonable enough prices. These restrictions will continue in force until the United States is once more at peace with Germany.

Exportation of American Dyestuffs

IN considering the development of the American dyestuff industry it is important to note that not only have manufacturers succeeded in keeping the domestic textile mills running, but have also exported considerable quantities of dyestuffs to other countries. A brief review of the total amounts of dyestuffs which left the United States during the past few years is of interest.

In the last entirely pre-war year, that is 1913, dyes and dyestuffs to the value of $347,655 were exported to foreign countries. This has steadily increased until in the fiscal year 1915 the total reached $1,177,925; in 1916, $5,102,002; in 1917, $11,709,287; in 1918, $16,921,888; in 1919, $17,865,365; and in the fiscal year ending June 30, 1920, a total of $25,792,565.

These figures require little explanation. The present exports exceed in value the pre-war imports, but of course the actual quantity is much less as the products are priced far higher.

One of the fundamental facts underlying German methods of production was their realization that their own mills did not consume sufficient quantities of dyestuffs to warrant manufacture on the most efficient scale. They discovered that in order to produce dyes at the lowest possible cost, it would be necessary to develop an extensive trade. It was for that reason that they were willing to sell their products even at a loss for a certain length of time in order to capture a certain foreign market. It was this idea which impelled them to devote all their energies toward making themselves the dominant factor in the dyestuff production of the world.

Certainly there is an extensive field within our own country for the consumption of domestically made dyestuffs. Nevertheless it is probable that manufacturers will find in time the need of still further increasing their market. The progress which has already been made in this direction is both encouraging and promising.

Dye Manufacture in Other Countries

THE United States has not been the only nation which has built up a domestic dye industry since the outbreak of the European war stopped the receipt of German dyestuffs. Four other countries in particular have been especially active in this line, namely England, Switzerland, France and Japan. An important difference between the development in European countries and that in America is the tendency of the former to consolidate the various manufacturing firms. For example, in Great Britain, the British Dyes, Ltd., represents the consolidation of certain important concerns and is, with the assistance of

Government backing, the all important factor in English dye production. The British Government advanced capital for the furtherance of the industry, and aided it in other ways. The English manufacturers have developed vat dyes derived from anthracene to a further degree than American producers, in view of the fact that the German patents were made available to the industry in the former country at a much earlier date than in the United States.

Switzerland was, of course, a prominent dye producing country before the war, ranking next to Germany in the amount manufactured, although even at that, far below the status of the latter country. In 1914, there were four Swiss companies making dyes, and these have later been consolidated. Switzerland is dependent upon other countries for its raw materials, but on the other hand has a more completely trained technical personnel. Satisfactory progress has been made during the war in the development of the Swiss industry.

France has also progressed to a considerable extent although, according to the Tariff Commission, this development has been far less than that in either Switzerland, England or the United States.

Dye manufacture is an entirely new field for the Japanese, but progress along certain lines has evidently been made in that country.

In general, it may be said that the effect of the war has been to make most of the important countries self-contained to a greater or less degree, so far as their supply of dyestuffs for the future are concerned.

Dye Outlook for the Future

IT is difficult to say much about the prospects for the future of the American dye industry, without becoming involved in a partisan discussion which does not properly belong in a news article. It must be admitted that to a certain extent the position of American dyestuffs depends upon what action is taken in regard to the protection of the domestic industry. This connection, however, has been somewhat confused in the course of public discussion. It is absolutely incorrect to say that dyestuff manufacturers are waiting to see what sort of legislation is passed before going ahead with further development plans. Such a charge is almost an insult to firms which have done so much in the past five years, and especially to firms like the National Aniline & Chemical Co., Inc., for example, which fought against overwhelming odds years before the war. The dye makers are permanently committed to the task of placing the domestic industry upon a sound and lasting basis.

Consequently while legislative action will probably not materially affect the efforts of American manufacturers, it must necessarily affect the results of their efforts. In place of the hymns of hate which emanated from Germany during the course of the war, there are now being sung hymns of woe. There seems to be a definite program on the part of German interests to describe the conditions of manufacturers in their country, especially in regard to dyestuffs, in as pessimistic terms as possible. The object of such a program is easy to understand. If the world were as gullible as Germans seem to believe it, reports of an absolutely crippled dye industry in that nation could easily induce other nations to take things easy and to refrain from prohibitive legislation, secure in their belief that the old dyestuff king is dead.

GROWTH OF ANILINE DYESTUFF INDUSTRY

	Number of Firms Engaged in Manufacture of Coal-Tar Dyes	Dyes Manufactured	Value of Products
1914	7	6,619,729 pounds	$2,470,096
1917	81	45,977,246 pounds	57,796,228
1918	78	58,464,446 pounds	62,026,390

Germany as a dye producing country is not dead. She undoubtedly has troubles of her own in securing raw materials, coal and labor with which to continue the conduct of her dye factories. She probably will continue to have trouble for some little time until her economic situation is more firmly adjusted. But she has her dye plants intact, her technically trained personnel still available, her strongly organized Cartel still in existence, and above all her Government to back the dye makers' efforts to the last degree. There are few methods which she would not utilize to regain her commercial supremacy and especially her dyestuff predominance. Consequently whatever other argument may be used to forestall prohibitive legislation in this country, the last one that should be used is the claim that we are building up a barrier against an enemy that does not exist. That is just exactly what the Germans would like us to believe.

The Future Bright

Irrespective of Congressional action, there has been realized during the past five years a great accomplishment which will never be lost. Americans have found out that they can make dyes as well as the Germans can. The American public has been aroused to the importance of the dyestuff industry and its national welfare. Everything points to a furtherance of our domestic production until we are absolutely self-contained so far as dyestuffs are concerned. Dye makers and dye users are at one in their belief that the industry should be fostered and encouraged. They differ in the method by which this result could be obtained. This difference has been productive of costly delay, but it bids fair to be straightened out at the next session of Congress.

Development in Industrial Chemical Manufacture

Effect of the War Is Adding Impetus to Domestic Production

CHEMICAL manufacture is decidedly the silent partner in the well-known firm of Dyestuff and Chemical Industries. It is silent in that little is heard from or of it in comparison with the publicity which has been given to the development of the dyestuff industry in the United States. Someone may start to talk on the general subject of both of these industries but will probably devote his entire discussion to dyestuffs. The reason for this apparent neglect is simple. Chemical manufacture has always been an important industry in this country and despite the remarkable impetus given to it during the war, its history does not carry the appeal that does the romance of the creation of an entire industry in five years as in the case of dyestuffs.

Nevertheless, there is much of interest to be gained by a consideration of the progress made in the manufacture of industrial chemicals in the United States. Unfortunately the subject is so broad a one and there are so many different materials to be considered that generalization on the subject of the chemical industry's growth is out of the question and particularization calls for far more space than could be given to it. Consequently it is only possible to touch the high spots.

In the first place it probably is not generally understood that previous to the outbreak of the war, we were dependent upon foreign countries for a fair proportion of our chemical supplies. Figures prepared by the Bureau of Foreign and Domestic Commerce show that during the last pre-war year, we imported chemicals to the value of $48,278,293 while we manufactured chemicals to the value of $173,269,000. These figures, however, do not by any means show the full extent of our dependence. It is a trite saying that a chain is no stronger than its weakest link but it applies to the case of chemicals. The proportion of imports to manufacturers does not seem so large but there are many substances for which we were almost hopelessly dependent on other sources.

Probably the best way to illustrate the progress made in chemical manufacture is to take up a few of the products most used in textile manufacture and compare the present imports and exports of same with those of prewar years. But first a little should be said regarding the actual effect of war conditions on our chemical resources. Not only did the conflict shut us off from many sources of supply but its resulting military demand called for the use of greatly increased quantities of many important materials. Long before the United States entered the war the manufacture of ammunition for the Allies called for enormous quantities of specialized chemicals. Our entrance into the fight further intensified this demand. In addition the sudden development of a dyestuff industry entailed a need for an immediate output of great quantities of chemicals used in the manufacture of the various intermediates and dyes. In fact the chemical industry and the dyestuff industry have been so closely allied that credit for the development in dye manufacture in this country must be divided between the two.

Progress Made in Important Chemicals

IT is difficult to guess relative importance of the various chemicals, but probably no material comes in for such a wide variety of uses and is needed in so many different industries as does sulphuric acid. Consequently it is worth noting that in the fiscal year of 1914 there were exported from the United States less than 10,000,000 pounds. This steadily increased until in 1916 there was exported over 80,000,000 pounds, declining gradually from that point until in 1919 there was exported somewhat less than 50,000,000. In other words we have supplied over five times as much sulphuric acid to other countries during the last fiscal year as in the last pre-war year. Unfortunately, however, this does not indicate the extent to which the manufacture of sulphuric acid has been increased, as the latest Census of Manufactures has not been published. It is safe to state, however, that, with the increased call for this material, domestic production has shown a remarkable growth.

Caustic Soda

Our imports of caustic soda have declined from over 650,000 pounds in 1914 to 2 pounds in 1919. Our exports have, on the other hand, materially increased and in the fiscal year, 1919, we exported over 125,000,000 pounds which represents one-fourth the total amount manufactured in this country in 1914.

The amount of caustic soda manufactured in the United States in 1918 was 513,363 tons, as compared with 212,539 tons in 1914.

Soda Ash

In 1918, there were 1,390,628 tons of soda ash manufactured in the United States as compared with 935,305 tons in 1914. The value of the product showed a far greater increase, however, as in 1918 production was valued at $35,635,520, as compared with $10,937,945 in 1914.

Sodium Bichromate

Production of sodium bichromate more than doubled during the war and in 1918 there were manufactured in the United States 28,334 tons valued at $9,868,118, as compared with 1914 figures of 11,824 tons valued at $1,125,398.

Bleaching Powder

Our imports of bleaching powder have declined from over 76,000,000 pounds in 1913 to about 500 pounds in 1918, recovering only slightly to somewhat over 500,000 pounds in 1919. Nevertheless we have been able to take care of our domestic needs and to export over 15,000,000 pounds in 1919.

One of the chemicals most seriously affected by the war was potash. The various salts of this material find a wide and varied use in the country's industries. The shutting off of imports from Germany created a serious shortage in these commodities. For example, imports of refined carbonate of potash declined from 14,035,111 pounds in 1913 to 130,040 pounds in 1919. Caustic potash was listed as "caustic or hydrate of potash, unrefined," previous to 1915, and after that year as "hydrate of potash, containing not more than 15 per cent of caustic soda." Under the first heading, 8,565,451 pounds were imported in 1914; under the second heading, 4,993,471 pounds were imported in 1915, declining to 11,732 pounds in 1918, and recovering slightly to 466,620 pounds in 1919.

The effect of this decline in imports resulted in considerable development in the research and manufacturing work in connection with potash materials in this country. New sources of supply were carefully investigated, among which the extraction of potash from kelp, a form of seaweed, came in for considerable notice.

Naturally the situation of potash caused a remarkable increase in the selling prices of the materials derived from it. Many potassium salts went practically out of sight and it was found necessary to use salts of sodium in a number of cases where the potash products had previously been utilized. To a greater or less degree, this substitution has persisted since the close of the war. For example, bichromate of soda is now being used in many cases where bichromate of potash was formerly considered necessary.

General Remarks

These are only a few of the chemicals which are of importance in the textile industry. Speaking generally, it can be said that the war necessitated the development of the production of chemicals to a remarkable degree. All along the line there has been evidence of new capital being invested and of new methods being perfected.

Price Fluctuations in Chemicals

THE shutting off of many sources of supply and the marked increase in the demand for many products naturally resulted in a phenomenal advance in chemical prices during the years of the war. These were not so acute as the price increases in dyestuffs but were sufficiently marked to represent a new era in chemical price history. It is of interest to note a few of these advances.

Caustic soda, 76 per cent, which sold in the neighborhood of one and one-half cents in 1914 advanced to a high of seven cents in 1918. Aqua ammonia, 26 degree, quoted at about five cents in 1914, sold as high as eighteen cents in 1918. Bleaching powder which was quoted at a fraction over one cent in 1914, sold at more than six cents in 1917 and is in fact, today in a nominal position in the market, ranging from seven to eight cents. Caustic potash, 70 to 75 per cent, quoted at approximately 3½ cents in 1914 was priced at 80 cents in 1917 but has since declined to somewhat under 25 cents. Bichromate of potash, which sold at around seven cents in 1914, was quoted at over 40 cents in 1917 and 1918, while bichromate of soda, during the same period advanced from 4½ cents to 18 cents and has since sold considerably over the latter figure during a recent period of fluctuation. Acetic acid, quoted at about one and one-half cents in 1914, sold as high as six cents in 1918.

There was of course, a wide variance in the amounts of increases occurring in the prices of the different chemicals. The general tendency, however, has been upward during the war, with declines following the cessation of the needs of chemicals for military purposes and the extension of the domestic manufacturing industry.

Financial Status of Chemical Industries

AS the Census of Manufactures published by the Government has not been issued since 1914, it is difficult to estimate the present status of the chemical industry. It is, however, of interest to note the conditions outlined in the last census that of 1914.

In that year the chemical manufacturing industry had an investment of $3,034,209,000. This was a very fair portion of the total amount invested in manufacturing that year which was over $22,000,000,000. It showed a remarkable increase since 1899 when the amount of capital invested in the chemical industries was only $1,163,816,000.

There were over 12,000 wage earners engaged in the chemical industries in 1914, representing an increase of 3,000 since 1899.

Barytes and Barium Products

Interesting Report Issued by the United States Tariff Commission

THE United States Tariff Commission has just issued an interesting report on the Barytes, Barium Chemical, and Lithopone Industries of the United States. The products of these industries have widely diversified and important uses, though the average person has little familiarity with their sources and relation to national life. Barytes is a mineral found in natural deposits. In its ground form and when converted into lithopone and the braium chemical, blanc fixe, it is used for white pigment in paints, artificial ivory and other manufactures and as fillers in paper, rubber goods, linoleum, oilcloth and window shade cloth. Some of the barium chemicals are of military significance, as evidenced by their use in green signal lights, in "battle ship grey" paint by the Navy, in tracer bullets in aeroplane ammunition, and in the manufacture of the antiseptic, hydrogen peroxide. Other uses include the manufacture of color lakes, certain kinds of optical glass and enamel ware, in X-ray photography and in the purification of table salt.

Formerly Dependent on Germany

The report is a survey of the three related industries, showing the developments in the United States as an outgrowth of war conditions, analyzing the costs of production, and pointing out the conditions confronting the industries when international trade is resumed. Domestic requirements of barium chemicals were supplied wholly by imports prior to the war, Germany furnishing two-thirds. The lithopone industry, then restricted to the Atlantic coast district, was entirely dependent on imports for its supply of the essential raw material—crude barytes—which could be imported from Germany at a cost less than at which the domestic product could be purchased. German domination of eastern markets for crude barytes restricted the domestic mining industry to Missouri and to supplying Middle Western manufacturers of ground barytes. Ground barytes, however, manufactured in the St. Louis district could compete in eastern markets with the imported product. The imports of crude barytes supplied 35 to 45 per cent of the total domestic consumption.

Large Development

The production of crude barytes increased four-fold, because of the cessation of imports and the consequent development of domestic deposits, the establishment of a new barium chemical industry, and the natural growth of other consuming industries. The increased output was accomplished largely by the development of deposits of barytes in Georgia, Tennessee, and Kentucky, and by a doubling of the Missouri output. In 1916, Georgia became the leading producing State, the position formerly held by Missouri.

War conditions resulted in the establishment of a new barium chemical industry in this country. The output of barium chemicals in 1918 had reached 46,000,000 pounds, or 2½ times the 1914 importation. The increased demand for barium chemicals caused a great increase in price, which, as domestic manufacturers met the total demand, declined to prices in 1918 about twice the normal pre-war price.

The lithopone industry has increased its output nearly six-fold from 1910 to 1919. This growth is a result of increased uses of this commodity rather than to war conditions. The domestic industry has had relatively little competition from imports, and during 1920 a considerable export trade in lithopone was developed.

An adequate supply of crude barytes is essential to the lithopone industry and should be given attention in consideration of duties on lithopone and crude barytes. Crude barytes accounts for about 14 per cent of the factory cost of lithopone. This percentage of cost due to crude barytes is important in considering duties on these two products.

Copies of the report may be obtained for 15 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

EXPORTS OF CHEMICALS

United States Holding Its Foreign Trade in These Materials

Official statistics for the fiscal year 1920 demonstrate that this country has been able to keep its trade in chemical and allied products very near the high mark set during the war despite the loss of markets for purely war supplies and despite the pressing demands that must be met in the domestic market.

Such is the conclusion reached by O. P. Hopkins, a well-known statistician, writing in the current number of the *Journal of Industrial and Engineering Chemistry*.

"In almost all lines except munitions," he writes, "the exports in 1920 exceeded in value those of 1918, a fact that can be explained in some cases, perhaps, by rising prices, but which nevertheless warrants the assertion that the position has not been weakened. These exports, which very greatly exceed those of the last normal pre-war year, are made up almost entirely of manufactured products.

"Imports have more than held their own and comprise raw and partly manufactured products required for further advancement by American chemical manufacturers.

"A very rough estimate puts the total value of exports of all chemical and allied products at a billion and a quarter dollars in 1920, a slight increase over the total for 1918, and about four times the figure for 1914, the last normal year, a full year of America's participation in the war and the year just closed. Imports, estimated in the same rough way, were valued at more than a billion and a half dollars in 1920, an increase of some 80 per cent over 1918, and nearly four times the total of 1914. Both exports and imports have quadrupled since 1914. Sugar is included in these totals and accounts for much of the increase in imports.

"Although values are no longer a reliable guide in making trade comparisons, a summary table of values has been compiled to show at a glance the tendencies in the chemical trade for the fiscal years ended June 30, 1914, 1918, and 1920; that is, the last normal year, a full caustic soda the world over.

"Imports have fallen off as compared in value with those of 1918, but considering the rise in prices, the total is probably about the same as in 1914.

The Growing Dye Industry

"We are nearly two years away from the armistice, yet the German avalanche of dyes has not overwhelmed us—a circumstance attributed in some quarters to the fact that we have had 'more luck than sense.' The protection asked for at home has been withheld, but outside circumstances have postponed the crisis. Statistics show that the value of imported dyes, dyestuffs, and dyewoods of all kinds has decreased since 1918, but the quantity of synthetic dyes has increased somewhat, the bulk of the supplies still coming from Switzerland. The imports of natural dyes and raw materials have fallen away as the domestic industry developed. In the meantime our exports of aniline dyes have more than doubled, reaching a value of $17,000,000 in 1920, while our sales of logwood extract and all other dyes have shown a slight falling off. A year ago Japan was the principal purchaser of our synthetic colors, but the largest shipments now go to China and India, where the textile industry is developing rapidly. All in all it is conservative to say that the industry in this country has been developed more successfully than in any of the other countries that were thrown upon their own resources in 1914."

The American Industry in Dyestuff Intermediates

Monthly Production of Important Materials Now Greater Than Former Importations

By *D. H. Killeffer*

DYE consumers are prone to consider the manufacture of dyestuffs as more or less a practice of the black art by young Americans or bearded foreigners, who have in some way inherited the secrets of their ancient forbears, the alchemists. Bearing out this impression the plants in which these dark deeds are performed are usually very dingy to look at, situated as far as possible from immediate neighors and carefully guarded by watchmen stationed at intervals along a high enclosure and able to loose clouds of vile smelling fumes at will upon any offending trespasser. The further impression that Germany is, was, and will be the sole and only source of chemical knowledge and dyes worthy of the name persists in a surprising number of cases. Certain it is, however, that the industry has long outgrown the retort and test tube of the philosopher and equally true is it that Germany can not now be considered "sole and only" in the field. As to the future, only the decision of the tariff question can give us a basis upon which to forecast.

From the dyer's point of view his colors come from a single type of plant which uses coal in some mysterious way to get "by-products" from which the dyes are made. So hazy is the general conception of "by-products" that a clever faker recently got together quite a financial following for the purpose of simply washing coke with water to extract dyes direct, and it was only with great difficulty that the humbugged were convinced that each ton of coke had had a hundred pounds or so of methylene blue added to it in the grinding!

The conversion of coal to dyestuffs is certainly no such simple process. It is the purpose of this article to call attention briefly to the very necessary operations between the coal and the finished dyestuff. Four distinct steps are necessary, each employing its own particular methods, men and plant equipment, and each using the finished product of the preceding process as its raw material. The coal must be distilled yielding coke, coal gas, ammonia liquor and tar. The tar, which is, strictly speaking, the only "by-product" in the dye industry, must be distilled, yielding a dozen or so, more or less highly refined materials, (benzine, toluene, napthalene, anthracene, etc.), which may be classed as "coal tar crudes." From these crudes are made some ninety commercially important intermediates which the dyemaker combines to form a thousand finished dyes.

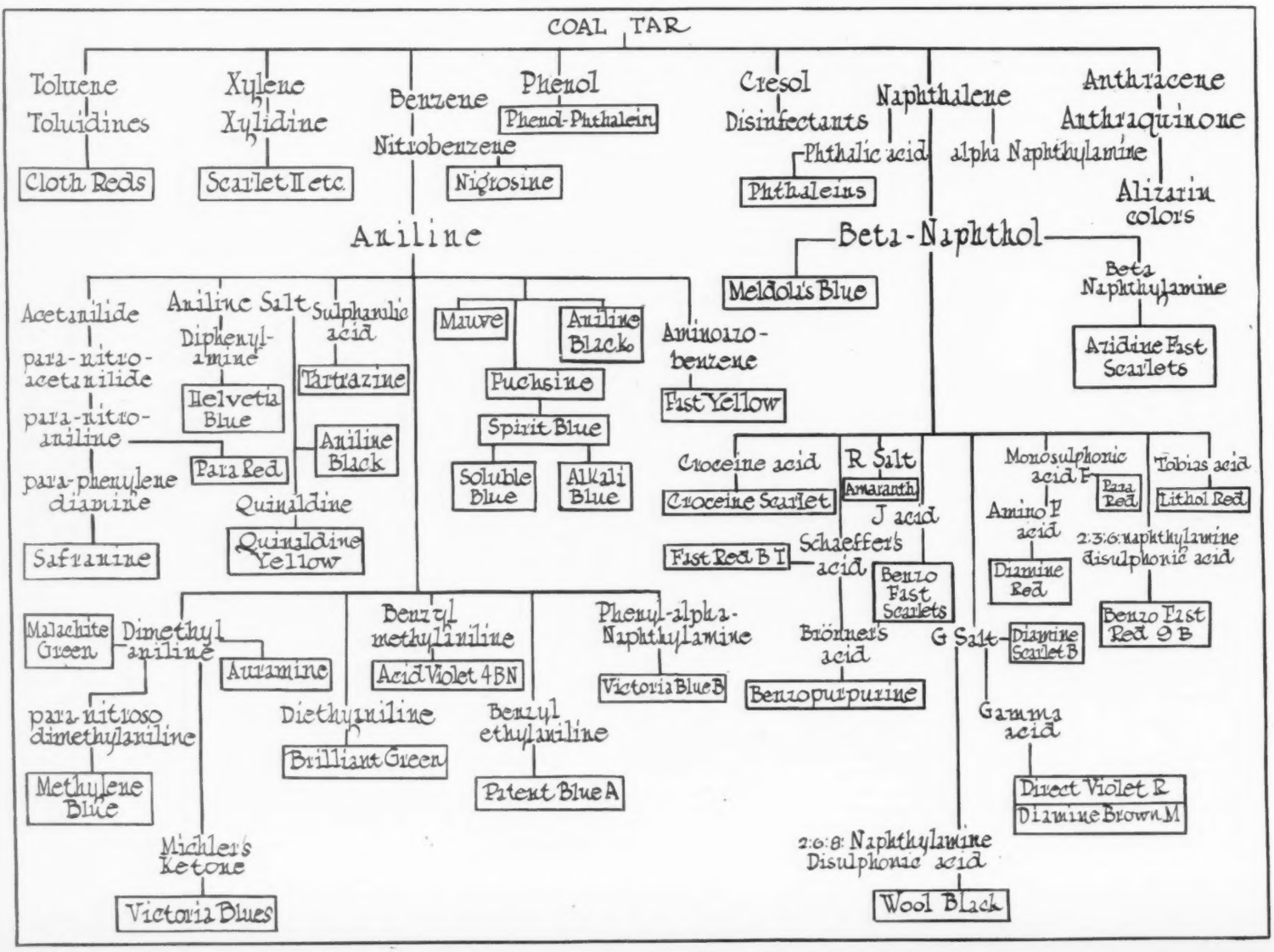
Distillation of Coal

The distillation of coal is carried out in a variety of ways to yield larger proportions of any of the products at the expense of others. Originally, the products desired were either coke or gas. In the first case it has long been the custom to use beehive coke ovens, which allow the gas and tar to be wasted. In gas manufacture, the ammonia liquor and tar must be recovered in purifying the gas. The first ovens in this country, designed especially to recover the tar and ammonia, were built by the Semet-Solvay Company in 1892, for the purpose of supplying ammonia for their soda works. Since that beginning there have been many similar ovens built by the iron and steel manufacturers to supply their requirements of coke. However, it was not until 1914, when a pressing demand for the distillation products of coal tar came into being here that by-product ovens became the rule instead of the exception.

Before it was possible to obtain dyestuffs from Germany, the distillation of the tar from the gas works in this country was largely a rule of thumb proceeding which yielded not only a few semi-refined products, such as solvents, phenol, naphthalene, disinfectants, pitch, etc., for which a demand existed here. From time to time immense quantities of these crude tar distillates were sent abroad to be refined, made into dyes and returned to the American markets greatly enhanced in value. Since 1914, however, refineries have been erected to meet the demands of the intermediate manufacturers for greatly increased output of highly refined products. So much for the raw materials supplied to the makers of intermediates.

Early Intermediate Production

The demand for intermediates before 1914 was very limited and the "dump-



ing" policy of the Germans in the absence of proper tariff protection effectively prevented the establishment of an American industry on a paying basis. During the period from 1880 to 1883 when such protection was given, the American Aniline Works was the first to manufacture aniline in this country on an all American basis. During this same period and before, some ten plants were actively engaged in the manufacture of dyes from imported intermediates. However, the loss of profit resulting from the removal of the greater part of the tariff protection, before the industry was really on its feet, effectually ended any attempts to manufacture intermediates until the formation of the Benzol Products Company within the last decade. This company's aniline manufacture was carried on at a loss until the beginning of the war in 1914.

The situation in 1913-1914 of the manufacture of dyestuffs in America was briefly this: One plant was making one intermediate (aniline oil) at a loss and five plants were making some 120 dyes from imported intermediates. There were some 544 dyes imported in amounts exceeding 10,000 pounds per year. Four intermediates were imported in quantities of more than a million pounds per year, and eight others in quantities of more than 100,000 pounds per year, as may be seen from the following table:

IMPORTS FOR THE FISCAL YEAR 1913-14

	Pounds.
Nitrobenzene	1,087,911
Aniline salts	3,083,467
Aniline oil	1,444,772
Beta-naphthol	1,030,288
Dinitrobenzene	164,650
Dinitrotoluene	547,701
Para-nitroaniline	606,931
*Benzoic acid	278,896
Mixed toluidines	108,835
Ortho-toluidine	309,595
Alpha-naphthylamine	112,226
Meta-toluylenediamine	83,355

*The large quantity of benzoic acid imported is probably to be accounted for by its use otherwise than as an intermediate.

Progress Made

The comparative status of the industry then and now may be judged from the facts that now more than three hundred finished dyes are produced in this country from American made intermediates and that the monthly production of both aniline and beta-naphthol, the most important intermediates, is now much greater than the former annual importations. Definite figures are lacking, but a fair estimate places the monthly aniline production around five million pounds and that of beta-naphthol around two and one-half million pounds. No importations of importance of these intermediates have been made since 1915, and during the same period great quantities of both intermediates and dyes derived from them have been exported. The importance of these two intermediates to the dye makers may be judged from the fact that aniline and products directly derived from aniline enter into the manufacture of some 32 per cent of the dyes listed by Schultz and beta-naphthol and derivatives are necessary for some 23 per cent.

The problems encountered by the dyemakers in America have been many and varied, but none has been more difficult of solution than that of making the more complex intermediates from the simpler ones. True, the manufacture of such primary substances as aniline and beta-naphthol on a large scale from a mere laboratory beginning has been accompanied by many serious difficulties, but none of these has been as great as those met in the preparation of gamma acid, for instance. To the casual observer who has looked over the long lists of seized, enemy-owned patents, the building of the dye industry would seem simple for one having access to this great store of information. However, on no point was the calculating cleverness of the Germans better illustrated than in the choice of things to patent. Most of the actual dye-making processes have been the subjects of patents throughout the world, while few of the processes of making intermediates appear anywhere in the patent literature. A case in point is the preparation of Red Lake from beta-naphthol and 2-chloro-5-toluidine-4-sulphonic acid by the diazo reaction. The actual reaction is simple and well understood, having been patented in Germany, France, England and the United States, but when American manufacturers attempted to carry it out, they were unable to make the sulphonic acid. No patents could be found covering the entire preparation and a long and tedious research covering more than two years was necessary before success was finally attained. In this, as in numerous other cases, essential facts were concealed in a mass of non-essential data in the patents. Few such stumbling blocks remain however, and indications now point to a full line of colors within a short time.

A Difficult Task

However, the manufacturer of such materials still faces a long and difficult task after his products are first put on the market in making them pay dividends. In the cases of even the simpler intermediates which American producers have marketed for five years, expensive research staffs made up of highly skilled men are still employed in efforts to recover the comparatively small process losses which have taken so largely of the manufacturer's profits. Losses of even 1 per cent figured to the immense production basis of some of these products amounts to thousands of dollars a month. Yet in the cases of some of the more complex intermediates process losses as high as 30 per cent on a single step are not impossible.

Aside from actual process losses many other serious factors have interfered with development. The fume question has ever been of prime importance. Not only has this brought friction between manufacturers and their neighbors but it has forced them to pay consistently higher wages to a lower class of labor than in almost any other line of work. With labor as scarce as it has been during the past few years, the amount of time lost on account of fume poisoning by employes in the various intermediate plants has been appalling and the actual loss of material in process through the inefficiency of the mechanical operation of plants by such a class of labor has been enormous. The hurry call for dyes has been so great that this phase of the situation is still awaiting a more opportune time for solution.

Raw Material Problem

The problem of raw materials has been serious since the beginning. Coal tar distillers have faced much the same problems as others in the lack of technical skill and the impossibility of obtaining the proper equipment to make the pure materials required in sufficiently large quantities. Even at this late date there is much to be desired along this line from the intermediate maker's point of view, especially in the case of naphthalene. Early calculations on which refining plants were built were based upon the estimated domestic consumption of dyes and did not take into account the enormous export demand which has existed for American dyes. On account of this export trade none of the manufacturers in the series has been able to estimate with the necessary accuracy the requirements for his products, and enlargements of plants consequently had to be carried on in a very hurried and inefficient manner. This method of construction has led to greatly increased process losses which have tended to hold prices up even more than the abnormal demand has sometimes seemed to justify.

The export demand has been of such a nature that producers have had great difficulty in providing for it. In the past three years the value of our exports has more than doubled as shown by the following figures published by the Bureau of Foreign and Domestic Commerce:

Year ending June 30.	Value of exports of "Aniline Dyes."
1918	$7,298,298.00
1919	10,183,948.00
1920	17,130,397.00

It should be remembered in this connection that the heading "Aniline Dyes" is construed to cover intermediates, which have been very largely exported to Japan, as well as finished dyes. Even these figures are believed by many well informed on the subject to represent only a small part of the possible export trade in dyes.

Price Movements

Market conditions in intermediates and dyes generally for the past few years may be easily traced from the price of aniline. In 1910 before the Benzol Products Co., appeared in the field, the price of aniline was 10c. per pound, delivered in New York. However, as soon as the operations of the American concern began to assume the aspect of real competition in 1912, the Germans cut their price to 8c. per pound and even lower in special cases. Estimates based on present operations place the actual cost of manufacture in America at that time around 8½ to 9c. per pound, but the American firm continued operating at a loss until the outbreak of the war. From the fall of 1914 until April, 1915 the scarcity of aniline became rapidly more acute with American capital afraid to enter the field. The price peak came about May, 1915, when aniline oil was sold for $1.70 per pound in the primary market. At this level American capital became more confident and production on a large scale was pushed as fast as possible. Late in 1916, supply and demand had adjusted the price to around 25c. to 30c. per pound at which level it remained until after the armistice. The year 1919 saw a decline to 21c. per pound in June, at which time demand was very small on account of the general uncertainty of the German policy and stocks of dyes. Exports, of both dyes and manufactured rubber, for which large amounts of aniline are used, from this time on rose rapidly and prices reached a peak of 37½c. per pound in late April of the present year. Since that time the world-wide slump in buying has brought prices down rapidly until aniline was sold for as low as 20½c. per pound early in August. The outlook at present, however, is much brighter and all business seems content to await the outcome of the presidential election before resuming extensive operations.

Prices for other intermediates and finished dyes have followed very much the same course with beta-napthol, probably the only exception, in that its price was the last to follow the recent slump on account of a serious scarcity of raw material, naphthalene.

Relation to Explosives

Frequent mention has been made from time to time of the intimate relation between our dye industry and the manufacture of explosives, but few such discussions go farther than that. The prime point of contact lies in the fact that the dyes or explosives which are not derived from nitrogen compounds are very rare and it is safe to state that such dyes or explosives are rather to be classed as curiosities than as commercial products. In other words the dye industry requires an intimate study of the manufacture of nitrogen compounds and this knowledge is absolutely invaluable in the manufacture of explosives. Another definite connection exists in the fact that each of the crude products of coal tar may be made highly explosive by similar methods to those employed by the maker of intermediates. Coal tar products are thus highly necessary to the explosive industry and the only way to ensure a supply of these when need comes is to keep refineries running to supply the intermediate makers.

The prospect from the dye users point of view is for more colors and better colors, following the announcements of rapid progress in the manufacture of the more complex intermediates. Adequate protection from German commercial invasion in whatever form may be chosen remains the vital issue so far as all interested are concerned. American ability is no longer questionable as the records of accomplishment show and time only is needed to prevent the recurrence of the fiasco of 1883.

Production of Natural Indigo

The manufacture of synthetic indigo played havoc with the indigo planters in India and brought their profits down to a vanishing quantity. We understand that the Indian government persuaded the indigo planters to combine together and have their problems investigated by trained chemists, who now report that by improved methods of cultivation, extraction and marketing, natural indigo of a quality superior to synthetic indigo can be produced at a lower cost. This natural indigo has been selling in Asia for some little while and is now coming onto the English market. It will be interesting to find out if it can hold its own in Europe but the present high price of coal and all its derivatives will afford a good chance.—*Journal of Industrial and Engineering Chemistry*.

Italian Sulphate of Copper

Vice Consul James J. Murphy, Jr., reports from Genoa that the Italian annual need of sulphate of copper is from 70,000 to 75,000 metric tons. The amount left over from 1919 was 15,000 metric tons. This year's production up to June 15, amounted to 73,000 metric tons, and production continues until July 15. It is estimated that the total production will amount to about 80,000 metric tons. The needs of the Italian vine growers will, therefore, be more than covered.

The A. B. C. of Direct Cotton Dyestuffs

Development Made by the American Industry as Regards These Important Products

By *Oscar R. Flynn**

PRACTICALLY every kind of substance having a useful degree of permanence, not irritating or offensive, has been applied by some expedient to produce colored effects on cotton. Hence cotton dye, in its broadest signification, is any kind of natural or artificial dye or pigment.

The term substantive cotton dye is much more restricted in its meaning, applying only to those substances which are soluble in weakly alkaline water, capable of being extracted from such solution by pure cellulose, and of forming with it a colored combination quite similar in nature and color to the previous combination with the water.

It is within the province of chemistry to show the relationship between the physical and chemical properties of substances and their chemical constitution. In the case of the substantive cotton dyes, this can be done with considerable degree of success. From the formula of a substantive dye, it is possible to deduce many of the properties coming under the following heads,—

I Affinity for cellulose
II Color
III Tendency of color to change
(a) With heat
(b) With acids
(c) With alkalies
(d) With copper
(e) With light
IV Degree of solubility
(a) In water and in aqueous solutions of salt and acid
(b) In alcohol

The substantive cotton dyes, like most other coal tar colors, are derivatives of aromatic hydrocarbons, for the most part. In discussing the constitution of the dyes manufactured in America at the present time, three aromatic hydrocarbons are of prime significance viz.: Benzene, C_6H_6; Toluene, $C_6H_5CH_3$; Naphthalene, $C_{10}H_8$.

Explanation of Tables

Tables I, II, III and IV show the relationships of the important derivatives of these three hydrocarbons to each other and to the parent hydrocarbon.

Derivatives result from the replacement of one or more hydrogen atoms of the parent substance with elements or groups of elements. The tables show many derivatives formed by replacement in a single nucleus and also cases of replacement in two or more nuclei at the same time resulting in a linkage of nuclei. The derivatives shown in the four tables are not dyes but are simply stages in the transformation of the aromatic hydrocarbons into dyes. Speaking from this standpoint they are tables of crudes and intermediates, the term crude being applied to the parent hydrocarbon, the substitution products exclusive of the dyes constituting the intermediates.

In the tables of crudes and intermediates, the circle with six radial divisions represents the benzene nucleus with six replaceable hydrogen atoms; the square divided into eight triangular spaces represents the naphthalene nucleus with eight replaceable hydrogen atoms. Toluene, which is a derivative of benzene in a sense, is represented by the benzene figure with one space filled in with a cross which stands in the table for the methyl group CH_3.

The five chief substituting groups which figure in the derivatives are represented by marking the little areas in the nuclei with various shadings. These groups are: Nitro group, NO_2; Amido group, NH_2; Sulphonic acid group, SO_3H; Hydroxyl group, HO; Carboxyl group, CO_2H. Other substituting atoms and groups are represented by their ordinary chemical formulas.

It will be found that this or some similar method of representation is a great assistance to the memory as the resulting figures can be readily visualized and related one to the other.

Steps in Transformation

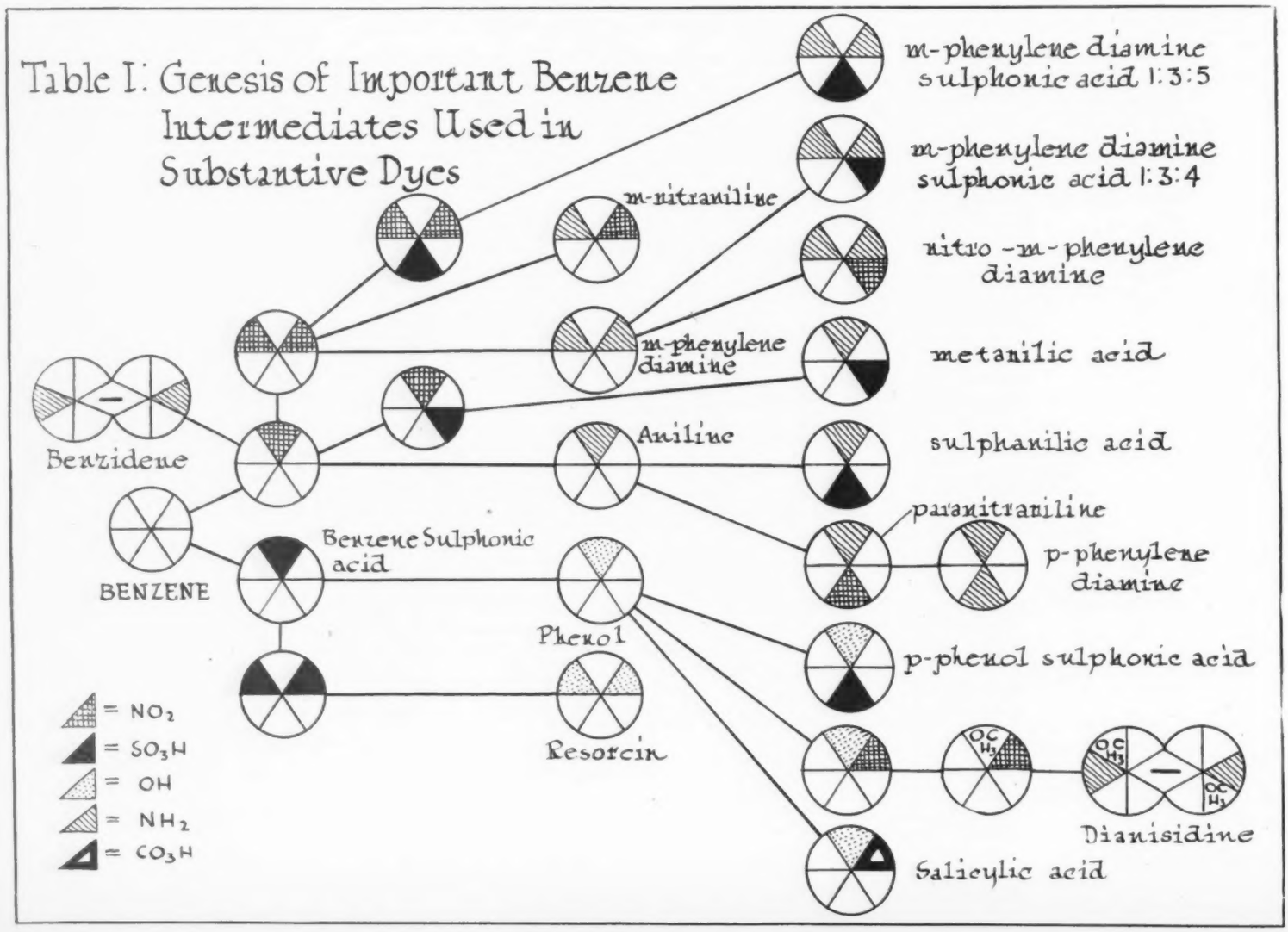
The first practical step in the transformation of the aromatic hydrocarbon into its derivatives is brought about by the action either of nitric or sulphuric acid, resulting in the formation either of nitro or sulphonic acid derivatives.

The operation of forming a nitro compound by the action of nitric acid is called nitration. The by-product is water. The action is made more energetic by the presence of some dehydrating agent, usually sulphuric acid. The chemical change is as follows:

$$XH + HONO_2 = XNO_2 + HOH$$

By this operation are formed nitro benzene, nitro toluene, and nitro naphthalene.

Examination of the figure representing the toluene nucleus shows the possibility of three kinds of derivatives which differ only in the location of the substituting group with reference to the methyl group. Where the group is adjacent to the methyl the term ortho is



* Chief Chemist, Waldrich Bleachery, Delawanna, N. J.

used; where it is separated by one space, the term meta is used in describing the relationship; where two spaces separate the introduced group from the methyl, the compound is described as para. By direct nitration we obtain a mixture of ortho and para nitro toluene which are separated and used for different purposes.

Sulphonation

The operation of forming a sulphonic acid, called sulphonation, is brought about by the action of sulphuric acid. The by-product is water. The action here again is more energetic and complete in the presence of substances which combine with water. For this purpose an excess of sulphuric acid is used and for still more energetic action a mixture of sulphuric acid with sulphuric anhydride, SO_3, under the name of oleum or fuming sulphuric acid. The chemical equation for sulphonation is:

$$XH + HOSO_2H = XSO_3H + HOH$$

Two toluene sulphonic acids are obtained,—ortho and para toluene sulphonic acid. There are also two naphthalene sulphonic acids formed by the sulphonation of naphthalene, known respectively as alpha and beta naphthalene sulphonic acids. The alpha is formed mainly at low temperatures and the beta above 180 degrees.

Further Nitration and Sulphonation

The nitro and sulphonic acid derivatives of benzene and toluene may be further nitrated and sulphonated to form di-nitro products and nitro sulphonic acids which may in turn be used as the starting point for further nitration and sulphonation giving tri-nitro products, di-nitro sulphonic acids and nitro di-sulphonic acids in all of which one law holds, namely,—The entering nitro or sulphonic acid group *does not* 'get next' to a nitro or sulphonic acid group already in the nucleus.

Where the number of substituting groups are more than two (and this includes the methyl group already in the toluene) their relative positions are best indicated by numbering. For example the di-nitro toluene sulphonic acid resulting from the further nitration of toluene sulphonic acid is the 6:2:1:4 di-nitro toluene sulphonic acid. The figure I here locates the methyl group of the toluene (see table II).

The nitro and sulphonic acid derivatives of naphthalene may in like manner be further nitrated or sulphonated but no such brief law may be formulated to describe the manner of its doing. The results however are best described by numbering such for example as nitro naphthalene trisulphonic acid 1:3:4:8, one of the chain of intermediates leading up to and beyond H acid.

Nitro derivatives may be transformed into the corresponding amido derivatives by reduction in acid solution most economically by means of metallic iron. In this way we obtain amido benzene or aniline; ortho and para amido toluene or ortho and para toluidine; meta diamido benzene or metaphenylene diamine; meta toluylene diamine; alpha amido naphthalene or alpha naphthylamine, and amido sulphonic acids and di-amido sulphonic acids.

Meta nitro amines are obtained by the partial reduction of di-nitro compounds by means of soluble sulphides, such for example as meta nitro amido benzene or meta nitro-aniline.

The equation representing the reduction of a nitro compound is as follows:

$$X'NO_2 + 6H = X'NH_2 + 2H_2O$$

The transformation of sulphonic acids into the corresponding hydroxyl derivatives is brought about in two stages. The first is by alkali acting at high temperature either in concentrated solution or under pressure. It is called caustic fusion and is represented as follows,—

$$X'SO_3H + 3NaOH = X'ONa + Na_2SO_3Na + 2H_2O$$

In the second action, acid is used:

$$X'ONa + HCl = X'ON + NaCl$$

By caustic fusion of the sulphonic acids of benzene with subsequent acidulation we obtain hydroxy benzene or phenol; ortho and para hydroxy toluene or ortho and para cresol; beta amido naphthalene or beta naphthol; di hydroxy benzene or resorcine; also naphthol and amido naphthol sulphonic acids.

Aniline, toluidines, naphthylamines and their derivatives can be converted into the corresponding phenols, cresols, naphthols, etc., by means of a diazo reaction described further on. This change can be effected in some cases by the action of sodium bisulphite and caustic soda. The diazo reaction can also be used to convert an amido derivative into the corresponding chloro derivative.

The general method of converting a hydroxy compound into the corresponding amine is through the action of hot ammonia under pressure.

$$X'OH_2 + {}_3NH_3 = X'NH_2 + H_2O$$

The change can also be effected by means of bisulphite and ammonia, a process the opposite of that used to convert the amine into the hydroxy compound.

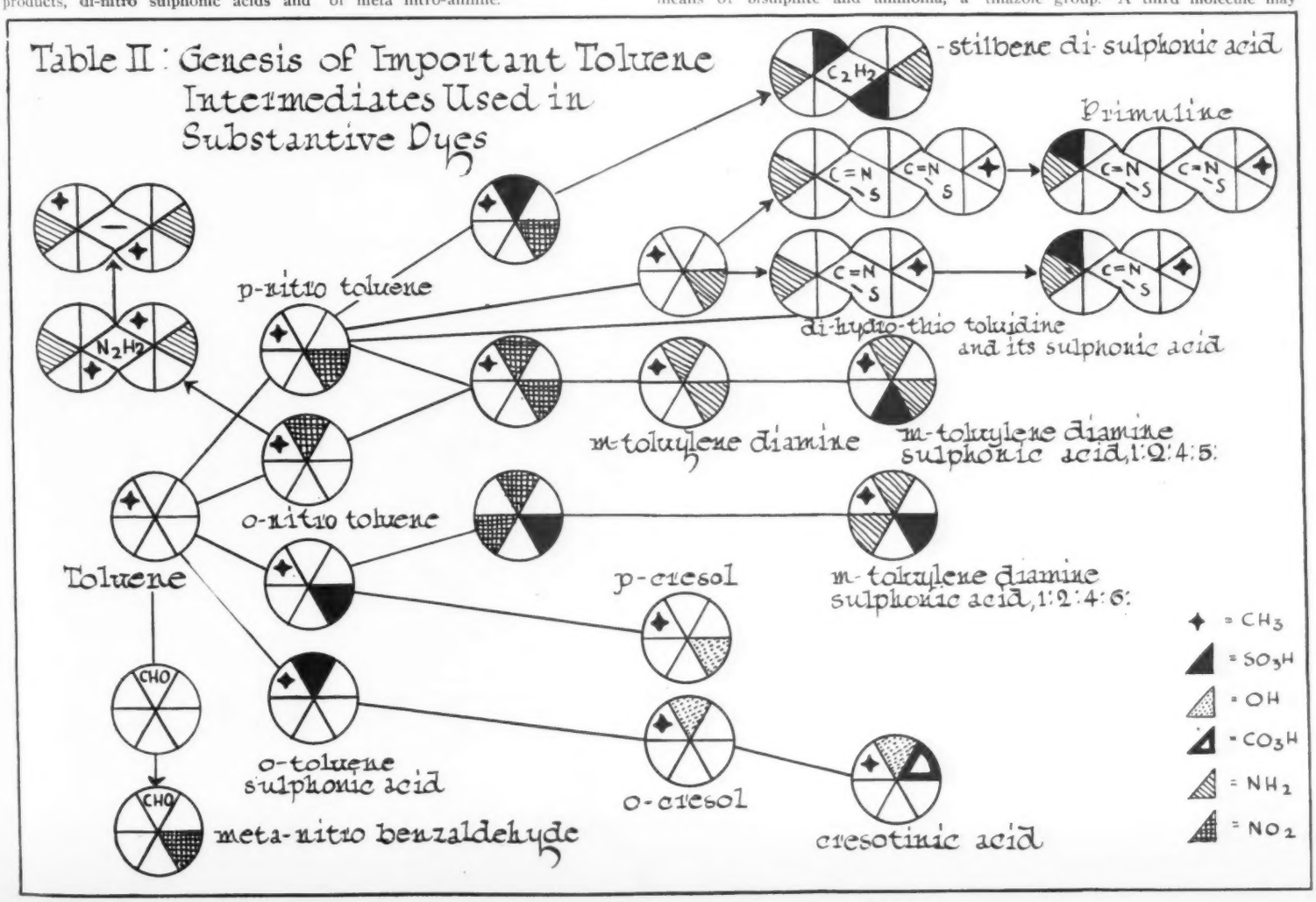
The sodium salts of the carboxylic acids of the phenols, cresols, and naphthols are formed by the action of carbonic acid under pressure upon the corresponding sodium compounds of the phenols, cresols, and naphthols.

Complex Intermediates

The majority of the one nucleus derivatives shown in the tables are made by the above reactions. The formation of intermediates containing two or more nuclei are described below.

Reduction of nitro compounds in alkaline solution by means of zinc causes in certain cases a linking of two nuclei to take place. In the case of para nitro toluene sulphonic acid 4:1:2 the nitro group is reduced to the amido group partly at the expense of the methyl group and two nuclei become linked by the group CH:CH, forming diamido stilbene disulphonic acid. When nitro benzene, nitro toluene, and nitro anisol are reduced in alkaline solution the hydrazo compounds are formed, viz: hydrazo benzene; hydrazo toluene; hydrazo anisol. These hydrazo derivatives are further transformed by acid into amido derivatives, the nuclei becoming joined together in the para position to the amido groups, giving benzidene, tolidene, and dianisidine.

Another important linking resulting in the formation of complex nuclei is brought about by the action of sulphur. When para toluidine is subjected to this action, dehydro thio toluidine is formed in which the nuclei become linked by the thiazole group. A third molecule may



be joined to the first two by further action of the same kind forming primuline base which yields when sulphonated the substance known as primuline.

Azo Compounds

The substantive cotton dyes with few exceptions belong to the substances known as azo compounds.

Azo compounds are formed by the reduction of nitro compounds, by the oxidation of hydrazo compounds, by other more obscure reactions, but principally by the action of a diazo compound upon the amido or hydroxy derivative of an aromatic hydrocarbon.

Diazo compounds are formed by the action of nitrous acid upon the salt of an amido compound. They are unstable for the most part and readily undergo change.

When heated in strongly acid aqueous solution they pass into hydroxy compounds. (The method referred to of transforming amido compounds into the corresponding phenols, cresols, and naphthols).

When heated in the presence of copper or copper compounds and strong hydrochloric acid they pass into chloro compounds. (Method of forming chloro naphthol disulphonic acid: 8:1: 3:6).

When heated with alcohol the diazo group is replaced by hydrogen with the resulting elimination of an amido group (Method of forming napthol sulphonic acid 1:3).

When brought in contact with an amido or hydroxy derivative of an aromatic hydrocarbon in the presence of weak acid or alkali in many places an azo compound is formed in which the two nuclei become joined together by the group N N, the para or ortho hydrogen to the amido or hydroxy group being eliminated.

By this process of linking, colored substances are formed which vary in shade with the derivatives which are joined.

In such an action the intermediate used in forming the diazo compound is the diazo component, the other is the azo component. Amido compounds act in both capacities; hydroxy derivatives serve only as azo components.

Diamines form tetrazo compounds uniting with two molecules of azo component which may be the same or different.

Some intermediates can act in a double capacity as azo component reacting with two diazo groups. Meta phenylene diamine, resorcin and H acid exhibit this property.

Still other intermediates may act as azo component and then be diazotized and coupled with another intermediate towards which they act as diazo component. The important intermediates which act in this way are aniline, alpha naphthylamine, and gamma acid.

Generally speaking hydroxy derivatives will couple most rapidly in the presence of alkali, and amido derivatives in the presence of weak acid. An azo component such as H acid which contains both hydroxy and amido groups couples adjacent to the amido group when the coupling takes place in acid solution; in alkaline solution the coupling takes place adjacent to the hydroxy group. It is possible by taking advantage of this fact to obtain two products making use of the same components.

In the majority of the substantive azo cotton dyes as well as in the comparatively few non azo substantive dyes it is possible to trace the affinity to cellulose to the presence of a certain aromatic derivative.

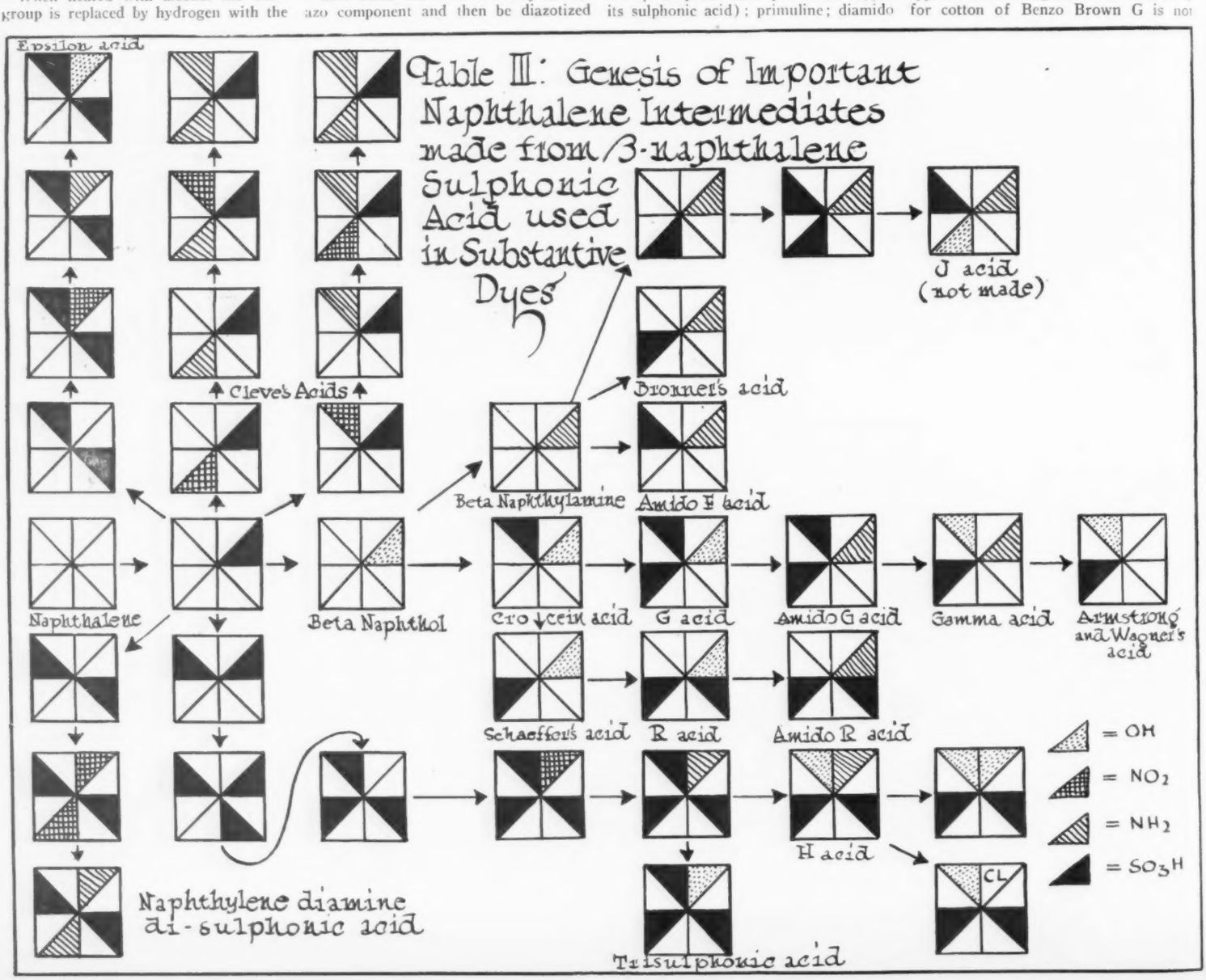
American Dyes

To explain the constitution of American dyes, it is sufficient to list the following intermediates which impart the substantive quality to azo combinations: m phenylene diamine; p phenylene diamine; dehydro thio p-toluidine (and its sulphonic acid); primuline; diamido stilbene disulphonic acid; benzidene; tolidine; dianisidine.

Benzo Brown G

To secure solubility in alkaline water the intermediates if not sulphonated as in the case of primuline and the sulphonic acid of dehydro thio toluidine and diamido stilbene must be joined with intermediates which contain sulphonic acid groups, carboxylic acid groups or hydroxy groups. Meta phenylene diamine, diazotized and coupled with more of the same substance, gives the well known basic dye Bismarck brown, soluble in acid solutions and capable of dyeing cotton mordanted with tannic acid.

By the action of two molecules of diazotized sulphanilic acid a dye is obtained which is soluble in alkaline water and capable of dyeing cotton directly. This is Benzo Brown G, one of the most extensively manufactured browns, a type capable of various modifications. For example, naphthionic acid may be used in place of the sulphanilic acid and in place of the sulphanilic acid and toluylene diamine sulphonic acid in diamine. It is quite possible that some one of the modified Benzo Brown G types is now being made. The affinity for cotton of Benzo Brown G is not



very good; the fastness to light and acids is inferior to Congo Brown G.

Direct Black FF

Para phenylene diamine cannot be made directly into a substantive dye. It is necessary to protect one of the amido groups by introducing the acetyl group in place of one of the amido hydrogen, making amido acetyl p phenylene diamine. The free amido group is then diazotized and coupled, after which the first group is restored, diazotized and coupled.

So far only one dye has been put on the market which is claimed to be a p phenylene diamine product, viz.: Direct black FF. The probable scheme of its formation is: m phenylene diamine—gamma acid—p phenylene diamine—Cleve's acid. It is possible that the American product contains resorcin instead of Cleve's acid as the quality of fixation with formaldehyde is claimed.

Thiazol Dyes

Substantive dyes which owe their capacity for dyeing cotton to the presence of dehydro thio toluidine, primuline and their related compounds are known under the general name of thiazol colors, and include yellow, orange, scarlet, and pink.

To the group of thiazol colors belong the only true non-azo direct cotton dyes. Primuline is itself a substantive dye. When oxidized with hypochlorite it gives rise to another non azo substantive yellow, one of the so-called chloramine yellows. Dehydro thio toluidine sulphonic acid treated in the same way gives a similar product of a greener shade. These yellows are not destroyed by any agency which can with safety be applied to cotton. Their reduction products are also yellow so there is no apparent change after treatment with hydrosulphite, although it will be found that the color has become sensitive to acid. Bleaching solution removes this sensitiveness and restores the original dye. Many brands of chloramine yellow are now being manufactured.

Thiazol Azo Dyes

Both primuline and dehydro thiotoluidine are capable of being diazotized and developed, when they give rise to various yellows, oranges, reds and pinks. The majority of the cotton reds now being made in this country and supplied as acid fast reds consist of primuline, diazotized and developed with naphthol and naphthylamine acids. Some of these yield a yellow when subjected to the action of hydrosulphite; this is the original primuline.

Many pinks are of this primuline type. The pinks of the diamine rose type are from 'dehydro' (as it is called for short) diazotized and developed with 1:8 chlor naphthol 3:6 disulphonic acid. The dehydro products unlike those made from primuline discharge white. They leave, however, a residue of chloramine yellow when the color is destroyed by hypochlorites and may be further identified by heating the dye with glycerine. When the heat has destroyed the red color, the glycerine solution remaining will be found to have a decidedly bluish fluorescence like a solution of quinine.

Primuline, diazotized and developed with resorcin, yields a useful orange fast to acid but considerably yellowed by weak alkali, requiring after treatment with acetic acid to give it reasonable fastness to storing.

Chrysophenine

Diamido stilbene di-sulphonic acid is mainly important in the production of chrysophenine.

When this base is coupled with two molecules of phenol a bright but unsatisfactory yellow is obtained. The least trace of alkali throws its shade from yellow over into a fiery orange due to the formation of phenol salts. This fault is removed by the process of ethylation.

Direct Yellow G

If caustic soda alone is allowed to act upon p nitro toluene sulphonic acid without the use of zinc dust, yellow or orange yellow substantive dyes are obtained which contain the same substantive group present in chrysophenine but linked together with azo groups and similar groups containing oxygen, in rather a complicated fashion. Variation in the strength and temperature of the caustic soda results in changes in the properties of the resulting dye as does the presence of organic substances such as formaldehyde and glucose. A yellow produced in this way was extensively used before chrysophenine was ready. It is best known by the name of direct yellow G. It was valued on account of its high degree of solubility but at the same time caused a great deal of trouble on account of its sensitiveness to alkali.

Oxidized Stilbene Yellow

By careful oxidation of direct yellow G with nitric acid or other similar agent dyes fast to alkali are obtained. A good many brands of oxidized stilbene yellows are still in use. They are generally identified with Diamine fast yellow A, although there is no evidence that this pre-war dye was an oxidized stilbene yellow.

Dependence on Chemical Constitution

It is in connection with the three remaining intermediates in the list of components importing the substantive quality that it is possible to show most completely the dependence of the various properties of cotton dyes on chemical constitution.

When any one of the three—benzidene, toluidene, or dianisidine—is coupled with soluble hydroxy derivatives or soluble amido derivatives of the aromatic hydrocarbons, direct dyes for cotton result. The color of the resulting dye is determined by the azo component but influenced by the diazo component in the following way:

Given similar products of the three bases it is quite certain that the dianisidine product will have a much bluer tone than the toluidine product, while the benzidine product will certainly be yellower than the corresponding toluidine product.

Dianisidine dyes have the property of forming blue compounds with copper, most quickly apparent when applied in the form of copper ammonia, the deep blue solution made by adding an excess of ammonium hydroxide to the solution of a copper salt. The compounds so formed withstand washing and in many cases are faster to light than the untreated dye. The reaction is sufficiently characteristic to serve as a test for dianisidine dyes, as the other diphenyl dyes are quite unaffected as far as the diphenyl part is concerned and where the azo component forms a combination of its own the change of color is toward red. The change with dianisidine itself overcomes the effect of the change resulting from the azo component so that a red dianisidine dye becomes essentially blue.

There are a great many known substantive dyes made with the three diphenyl bases in conjunction with a great variety of azo components.

List of Aromatic Compounds

Below is a list of the aromatic hydroxy and amido compounds which have been made use of in preparing the dyes of this class which have been manufactured and put on the market here in America since the beginning of the American dyestuff era. In grouping them use has been made of the color which they are known to produce when used as a developer with benzidene without any other intermediate. Where the necessary compound was not obtainable it was made so that the grouping according to this scheme may be considered accurate. The names used for the different classes of azo components will be readily understood, although fault may be found with the manner of their construction. We have then:

Chrysogens, including phenol, cresol, salicylic acid, and cresotinic acid.

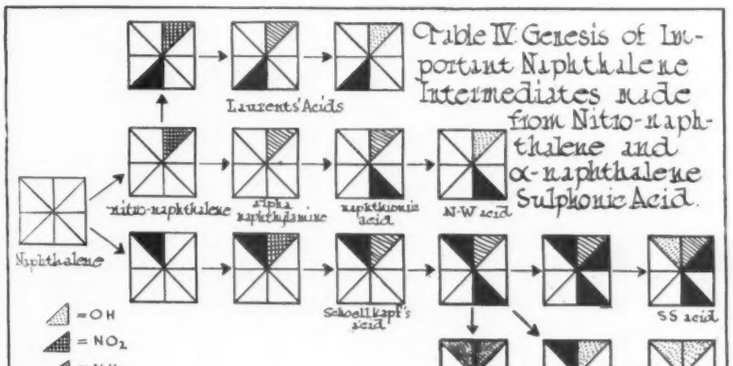
Pyrogens, including m phenylene diamine, m toluylene diamine, m toluylene diamine sulphonic acid and resorcin.

Rhodogens, including alpha napthylamine, naphthionic acid, Bronner's acid.

Violagens, including beta naphthol, crocein acid, Neville and Winthers acid, gamma acid (acid coupled), gamma acid (alkaline coupled), trisulphonic acid, R acid.

Cyanogens, including H acid, SS acid.

To these should be added complex azo components formed by coupling resorcin and meta phenylene diamine with sulphanilic acid, and H acid with aniline and paranitraniline. The general effect of this coupling is to increase the blueness of the resulting combination and in the case of sulphanilic acid to increase the solubility of course.



The first point to be considered in a discussion of the intermediates in the above list is the effect on solubility. The causes of solubility in alkaline water are the hydroxy groups, the carboxyl and the sulphonic acid groups. The hydroxy group is least influential; the carboxyl group is somewhat more so, and the sulphonic acid group most effective. Dyes which contain only hydroxy and carboxyl groups require soap or sodium phosphate to make them sufficiently soluble for dyeing purposes. They are, however, usually more soluble in alcohol than in water. Those which contain three or more sulphonic acid groups are generally quite soluble and easily leveling dyes. Four sulphonic acid groups are usually sufficient to make the dye soluble in acidulated water so that such dyes can readily be used as acid dyes for wool or silk. Dyes formed from intermediates containing only a few solublizing groups are apt to be rendered quite insoluble by being coupled or developed with intermediates which contain no sulphonic acid or carboxyl groups.

Action of Acids and Alkalies

The azo components used in forming the diphenyl dyes have a great deal to do with the tendency of the resulting dyes to change color with acids or alkalies.

The amido compounds are the ones which change most readily with acids. This seems to be the result of the tendency of such compounds to form ammonium-like salts with acids. The m phenylene diamine and m toluplene diamine when coupled to form substantive dyes change from orange to red and red to purple. The naphthylamine products change from red towards blue. Bronner's acid is less sensitive than napthionic acid and more sensitive than gamma acid, while H acid and SS acid are scarcely affected.

Alkalies exert their effect on the intermediates containing hydroxyl. These tend to form reddish compounds with alkalies in the nature of phenolates or naptholates. Phenol and cresol are very sensitive forming bright red compounds with weaker alkali, even with the alkali of soap. Resorcin compounds react in the same way. Salicylic acid and cresotinic acid are not affected by soap but change in the same general way as phenal with stronger alkalies. The naphthol dyes form reddish-violet compounds with strong alkali, but Neville and Winthers acid is the only one that forms compounds which are markedly sensitive to sodium carbonate. H acid is very slightly affected even by strong alkali. Gamma acid, alkaline coupled, is somewhat more affected than H acid. It is interesting to note that resorcin and m phenylene diamine are complementary so that when they are used in the same dye such as in iso diphenyl black the effects of acids and alkalies are counterbalanced.

Copper Compound Effects

Copper compounds, especially copper ammonia, affect the naphthols and the carboxyl groups causing the same sort of change in color as that produced by alkali but an effect which does not disappear in washing.

The mordant quality or the ability to form insoluble compounds with chromium hydrate is also associated with the carboxyl group in conjunction with the hydroxy group as it exists in salicylic and cresotinic acid.

Resorcin has the property of condensing with formaldehyde so that dyes con-

taining resorcin can often be made faster to washing by this treatment. Meta phenylene and m tolnylene dyes are supposed to have the same property.

Gamma acid when entering into the dye molecule as a naphthol i. e. when coupled in alkaline solution, retains as we have seen the property of being diazotized and coupled; hence the gamma acid colors (alkaline) can be made faster to washing by diazotization and coupling with non-solublized intermediates. Alpha naphthylamine also imparts the same property.

Sensitiveness to Heat

Sensitiveness to heat is really a question of dehydration. Most of the substantive dyes as they exist in the cloth are really hydrates. If it should happen that the anhydrous form has a different color, then the dye is sensitive to heat as heating decomposes the hydrate and leaves the cloth dyed with the anhydrous dye.

This change is most pronounced in the case of the naphthol dyes and especially noticeable in the case of dyes made from N W acid and trisulphonic acid. Naphthionic acid shows a tendency to be heat sensitive in combination with dianisidine; this is probably due to the change being rendered more conspicuous by the bluer shade of such a combination.

Fastness to Light

Fastness to light is associated with the yellow components and with gamma acid in acid combination. It is interesting to observe that dyes sensitive to acid such as these made from naphthionic acid fade much more rapidly in the presence of acid and it has been observed that a similar effect is produced on some alkali sensitive dyes in the presence of strong alkali.

Diphenyl Dyes

We now come to the actual diphenyl dyes as they have been made from the three bases and the different azo components. A pyramid has been constructed (Table V) so as to show each dye in relationship to the classes of azo components of which it is made. The lowest tier of this pyramid contains five blocks in which are the dyes containing

Yellow azo components only.
Yellow and orange azo components
" " red " "
" " violet " "
" " blue " "

An examination of this table reveals the fact that the yellow generating components enter into the composition of fourteen American made diphenyl dyes. All of these fourteen dyes will be found to change with alkali by a lessening of yellow in their color and an increase of the red, the yellows themselves becoming orange and the greens taking on a violet tone. The change will be least noticeable in the oranges, browns and reds on account of their color. The thirteen which contain either salicylic or cresotinic acid will be affected by copper permanently in the same way that they are affected by alkali and will be made faster to light and washing by the treatment. This same group will also respond to treatment with chromium compounds.

Yellows

The yellow chrysamine G and cresotin yellow G will be found to be rather insoluble. To overcome this phosphate of soda or soap should be used in dyeing, otherwise the dye will be merely filtered out of the water by the cloth and subsequently in starching will be dissolved and actually dyed on the fibre causing *springing up* of the color.

Oranges

Orange T A and benzo Orange R on account of the naphthionic acid are very sensitive to acid which turns them blue.

Toluylene orange G composed of a yellow and orange component is a yellower product than orange T A. Its low degree of solubility makes the addition of phosphate in dyeing desirable.

Browns and Reds

Benzamine brown, 3GO supposed to be the first American make of brown put upon the market shows a very considerable range of change in shade due to reddening effect of alkalies on the one hand and acid sensitiveness due to the m phenylene diamine. Its low solubility makes the use of soap or phosphate desirable to bring out the full color. Its acid and alkali instability makes it more suitable for hosiery than piece goods. Congo brown G, containing resorcin in place of m phenylene diamine, shows much less change with alkali and acid. This brown is not capable of being coupled as both capacities of the resorcin are already satisfied.

Diamine fast red F resulting from the combination of a yellow and violet component is dull in shade but of excellent degree of fastness. It consists of benzidene coupled with salicylic acid and gamma acid (in acid solution). To the salicylic acid it owes in addition to color its ability to be made faster to washing by action of chromium salts. Gamma acid does not impart sensitiveness to heat or to weak acid.

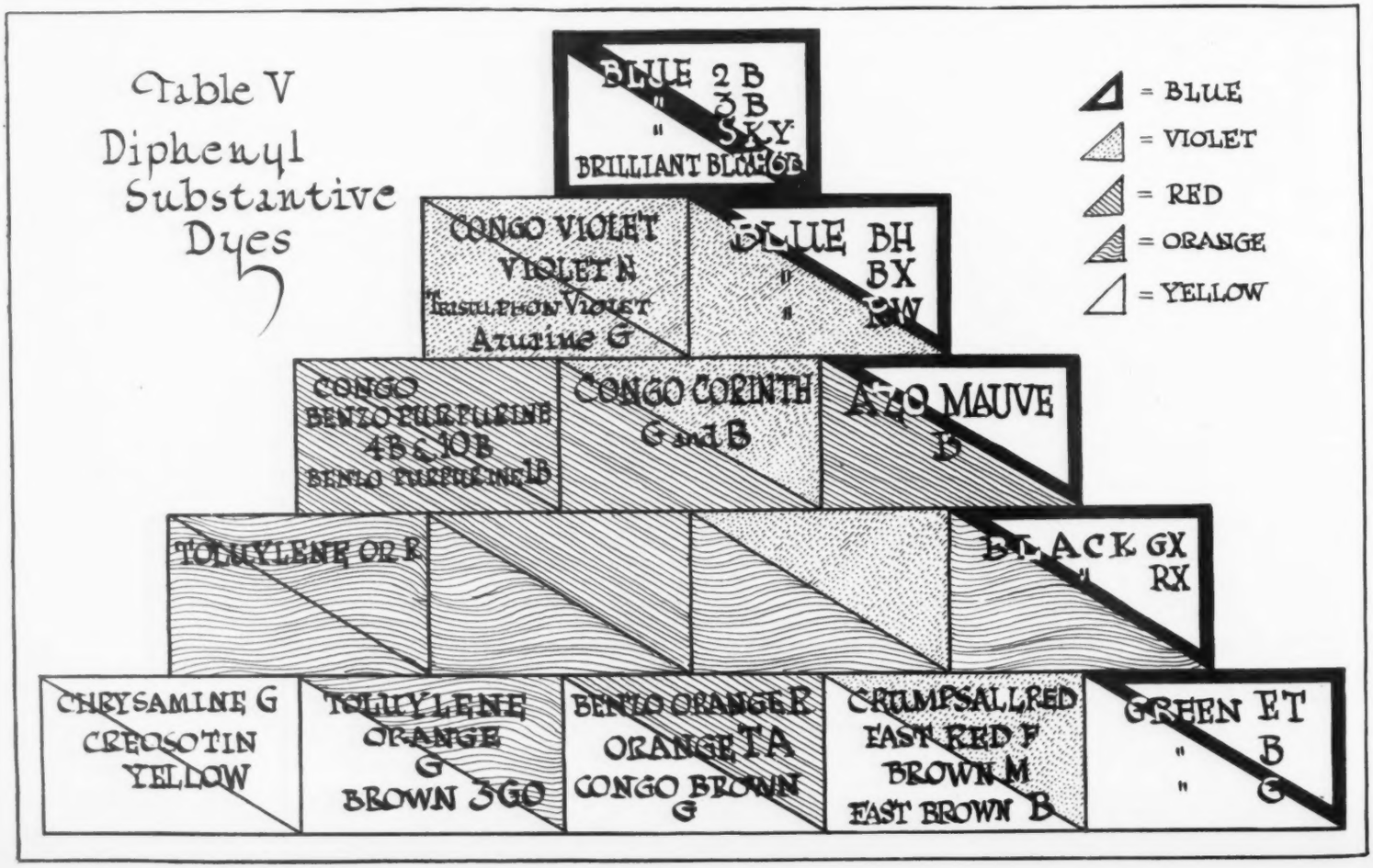
Brown M is similar in its properties and composition to red F. Gamma acid coupled in alkaline solution gives a bluer and duller effect than when coupled in acid solution; hence we have a brown rather than red, and a sensitiveness to heat which we find associated with the alpha naphthols. It not only responds to after treatment with chrome and copper on account of the salicylic acid but further has the property of being diazotized and developed and thereby being made faster to soap washing.

Crumpsall direct fast brown B has many of the qualities of brown M. It is duller and greener in shade but responds to the same kind of after treatment for the same reasons. It differs only in having the gamma acid linked to the benzidene through the intermediary of a molecule of aniline.

Crumpsall red is similar to these two, being a red resulting from the combination of yellow and violet components, viz. salicylic acid and R acid. It is not as fast to light as red F neither can it be diazotized like brown M.

Greens

The four available greens finish up the list of diphenyl colors in which the yellow generating components enter. Of these greens the G mark is the most valuable. It is formed by coupling salicylic acid and H acid with p nitraniline in acid solution and with benzidene in alkaline solution, finishing with salicylic acid. It is fast to acid and soap alkali; turns violet with strong alkali and copper due to the salicylic acid. Green B containing phenol as the chrysogen is still more sensitive to alkali.



In the second tier in the pyramid (Table V) are the diphenyl blacks containing the Pyrogens, m phenylene and m toluylene diamene respectively and resembling the greens in their make up.

Second Tier

These blacks, direct black GO and direct black RX are the commones blacks in use. They are not as suitable for light shades as black FF as the presence of the meta diamines makes them unduly sensitive to alkali.

Toluylene orange R, the only dye remaining in this tier, differs from the G mark in the elimination of the salicylic acid component with which disappears the capability of beneficial treatment with copper and chromium compounds and appears increased sensitiveness to acid, which reddens and darkens them and incidentally makes them fade.

Third Tier

Stepping up to the next tier we come to the dyes containing red generating azo components. Three contain naphthionic acid in combination with the three diphenyl bases and one contains Bronner's acid in combination with benzidene. The dyes in question are congo, benzo purpurine 4B, benzo purpurine 10B and benzo purpurine 1B. These products should be red, fugitive to light, fast to alkali, unaffected by copper with the exception of the dianisidine compound and the 1B should be somewhat less sensitive to acids than the others. The 10B will have much the bluest shade while congo will be more orange in tone than the 4B. Also the 10B will be most sensitive to heat.

The next block holds the names of dyes which are combinations of the red and violet components giving maroon or bordeaux shades. The two listed are congo corinth G and B containing naphthionic acid in combination with benzidene and tolidene respectively. An examination of the list of properties of intermediates will show that such a combination will be sensitive to both acids and alkalies and to heat as well as to copper.

In the last block of this tier is azo mauve B, a combination of blue and red generating components with a blue component. It is an acid sensitive dye and constitutes a cheap developing dye.

Fourth Tier

The fourth tier contains two blocks, the combinations of all violet azo components and those which contain both violet and blue components. Violet N, made from gamma acid coupled to benzidene in acid solution, is the best cotton violet manufactured at the present time. In its general properties it corresponds quite closely to fast red F from which it differs in the absence of the salicylic acid and its effects viz., sensitiveness to strong alkali, and to copper and capability of being fastened by chromium compounds. It has the fair degree of fastness to acid associated with gamma acid when acid coupled and also its permanency to heat.

Trisulphon violet is the most commonly used blue shade of violet. The tri sulphonic acid with three sulphonic acid groups give it a useful degree of solubility causing it to be level dyeing and useful for pad work, but also makes it fugitive to light and sensitive to heat and copper.

Congo violet, commonly called bordeaux COV, contains crocein acid, which is a beta naphthol sulphonic acid and gives it properties very similar to the preceding. In fastness to light it is if anything inferior owing to the weakness of the crocein acid in this respect.

The remaining dyestuff is a product of the violet component NW acid with dianisidene and due to the influence of the latter turns out to be a blue of a reddish tone. Azurine G is the name of this product. It serves very well to demonstrate the tendency of NW acid to produce a dye which turns a bright purplish red with heat and alkali and is not affected with ordinary dilute acid such as violently alters the shade of naphthylamine compounds. The copper effect is obscured by the stronger reaction of the dianisidine. Under normal conditions it would be a fairly cheap product.

The next block in the fourth tier has combinations of violet and blue components giving three reddish blues. Of these, blue BX has properties in common with the azurine G. Its sensitiveness to alkali and heat is however much less.

Blue RW is considered to be the most desirable blue of medium redness. The redness of tone is imparted by the beta naphthol which also lowers the cost, lessens the solubility and enables copper salts while improving the fastness to light at the same time to exert a marked effect in increasing the fastness to washings. SS acid gives the necessary solubility and constitutes the blue generating component.

Blue BH or black BH as it is variously called contains the blue component H acid and the dull violet component, gamma acid, coupled in alkaline solution. The resulting dye is a dull reddish blue. Its fastness to acids and alkalies is bound to be good but it should show about the same sensitiveness to heat which brown M exhibits, and this, as a matter of fact, is its chief fault when the attempt is made to use it as a shading color. The gamma acid gives it the property of being diazotized and further developed. When joined by this method to meta phenylene diamine it gives a black fast to washing especially suitable for hosiery. With resorcin it gives a still finer but more expensive black. With beta naphthol it gives a dull blue also quite fast to washing.

The capstone of our pyramid consists of the all blue combinations. Here for the second time we meet with a full set of diphenyl dyes this time showing the variation in shade resulting from the combination with H acid of benzidene, tolidine and dianisidine. Just as in the congo and benzopurpurine trio we find a diminishing of the red tone from blue 2B through blue 3B to Sky Blue. All these have the same general properties, viz., high solubility due to the presence of four sulphonic acid groups, good fastness to acids, alkalies and heat, associated with the 1:8 amido naphthols and low degree of light fastness. There is a difference among authorities in regard to the effect of copper in improving the fastness to light of sky blue.

In this group of four is found sky blue 6B, the brightest of the sky blues, and capable of being made much faster to light by after treatment with copper compounds. In other respects, its properties coincide with the H acid blues.

Progress of Industry

The progress of the development of the dye industry keeps pace with the manufacture of intermediate. The substantive dyes are especially dependent upon the supply of different naphthalene acids.

We can divide the history of the American industry into distinct stages:

The congo stage,
The H acid stage
The gamma acid stage
The J acid stage.

The latter stage is the one that we are just about to enter upon. With the full advent of this period we may look for the benzo fast scarlets, the azidine scarlets, the diazo brilliant scarlets and the rosanthrene color.

The Dyestuff Situation

Importance of Industry Calls for Particular Protective Legislation

By *Franklin W. Hobbs*, President of Arlington Mills, Lawrence, Mass.

ON December 9th, 1916, in an address delivered before the Boston Art Club, entitled, "Textiles; The Backbone of New England" among other matters I called attention to the dyestuff situation as follows:

"Up to August, 1914, the textile manufacturers and other users of dyes in this country had given but little

Franklin W. Hobbs

thought to the supply of dyestuffs. There was a plentiful stock of dyes, a few were made here, most of them were imported, the prices were whatever the dealers asked, and little attention was given to that part of the business. A few weeks after the war all was changed. The supply was uncertain, prices began to rise, a few ships came in with dyes from Germany, and then after some months England enforced the blockade and Germany could send no more. Then the American consumer of dyes suddenly awoke to the situation and consternation and panic followed. Prices soared, and even at high prices the supply was practically exhausted.

"The situation was serious, not only in textiles, but in every business where colors were needed—ink, leather, paper and even the ornamental cherry at the bottom of a famous American drink was threatened! It looked like an era of black and white. And then the American dyestuff manufacturer came to the rescue. Fortunately for all of us, there were a few men in the United States already engaged in a small way in the manufacture of dyestuffs, mostly made from imported intermediates or partly manufactured dyes. These men had the ability, the courage, and the foresight immediately to enlarge their plants, and to attempt to meet the situation. They went ahead doubling, trebling their plants, and investing great sums in the business, having confidence that the American people would see that their enterprise was protected against foreign competition after the war, if they took the risk then.

It is not generally understood that a plant making dyestuffs can be turned in time of need into one for the manufacture of explosives, as the same raw materials and the same apparatus are used for both purposes. The famous dyestuff plants of Germany are running today to a great extent on explosives, and the establishment of the great dyestuff industry in Germany was a part of their plan for national preparedness; a commercial success in peace and a national necessity in war.. Let us profit by their example and our recent experience, and see that the dyestuff industry is established on a firm basis in this country, not only to provide the needed dyestuffs for our mills, but to make certain the absolutely essential supply of explosives for our national defense."

Expresses Situation Today

Although this was written four years ago, to my mind, it expresses the situation as it stands today.

During these four years many new colors have been added to those that were available at that time. Many more colors will be produced on a commercial scale in the near future especially some of those required by the cotton manufacturing industry.

The question now before the American people is whether we shall preserve this industry in this country or turn it back to the German concerns. There has been some difference of opinion as to the exact method by which the industry can be established on a firm basis, but it has seemed to me that under existing conditions of trade and exchange that no schedule of tariff duties would be effective to protect the industry from an attack by the great German dyestuff Cartel. The situation is so peculiar with reference to the dyestuff industry that some of us have felt that it needed special treatment and for that reason have advocated a bill along the lines of that finally devised by the Finance Committee of the United States Senate which would secure for the American consumers of dyes all dyes that were not made in this country at reasonable prices and in reasonable commercial quantities and yet at the same time would prevent unfair competition against the dye manufacturing industry.

As large users of dyes in the wool manufacturing industry we have obtained satisfactory results from the American made dyes and, in our judgment, the American people are today receiving goods dyed as well and as fast as was the case when the German dyes were the only ones in use. Such being the case, I think that this industry should be maintained, not only for the benefit of the different branches of manufacture which use dyes, but also in order to make certain an adequate supply of explosives for our national defense.

Activities of the Chemical Foundation

Administration of German Patents a Vital Part of American Dye Development

IN considering the growth of the American dye and chemical industry since the shutting off of German products threw this nation on its own, there is one organization whose function and importance must not be overlooked. This is the Chemical Foundation, Inc. This body shares with the Textile Alliance, Inc., the doubtful honor of being one of the two most misrepresented factors in connection with the dyestuff industry. In the unfortunate political tangle in which the entirely unpolitical question of dye protection became involved these two bodies have often been designated by uninformed persons as the very essence of the imaginery American dye monopoly which has been constructed as a useful bugaboo.

As a matter of fact no two organizations in the country have meant more to the development of the dye industry and consequently to the protection of the dye consuming industries than have these two.

The Chemical Foundation, Inc. was formed in the year 1919, to take over approximately 4,500 German patents referring to the chemical, dye and allied industries. There were, of course, a certain number of these which did not strictly fall under this classification, but to be on the safe side a broad group was included. After these were carefully investigated it was found that approximately 3,800 pertained to the above mentioned industries. It devolved on the Chemical Foundation, Inc., to license these patents to prospective manufacturers.

A Complicated Task

The magnitude of this task may be partly appreciated when it is stated that the data received by the Chemical Foundation, Inc., consisted of practically nothing but the bare names of the patents involved. It was accordingly necessary first of all to properly classify these before licenses could be issued intelligently. This work was done under the direct supervision of Dr. S. A. Tucker. Cards were prepared on which an abstract or more properly a brief of each individual patent was printed. This brief consisted of the essential points brought out by the patent in question. In addition the card contained the patent issue number and date, and the patentee's name. After this important work was completed a series of pamphlets was prepared containing briefs of the various patents classified for the assistance of prospective manufacturers. For example, there has been a pamphlet on vat dye patents, one on drug and medicinal patents, one on metallurgical patents and one on paper patents. Others are in the course of preparation and will be issued as soon as possible.

Issuance of Licenses

The actual licensing of patents involves a great complexity of considerations. The usual procedure is as follows: The Foundation attempts to ascertain manufacturers who would be interested in using certain of these patents. It is necessary first of all to make sure that the prospect was all American. This was from the beginning one of the primary conditions of the plan and its wisdom will be realized when it is appreciated that the taking over of the patents was devised as an aid toward the building up of a truly American industry. Furthermore, the prospective manufacturer must prove to be financially responsible because the successful use of the patents depended upon this. The applicant is also asked to furnish data regarding his technical equipment and manufacturing plant. In the case of a patent which had not been licensed before, it is necessary to secure information as to market conditions, costs and extent of demand for the material under consideration.

Fixing of Royalties

An interview is accordingly arranged with the prospective licensee and the question of the royalty to be paid for the use of a patent decided upon by mutual agreement. It is on this subject that the greatest amount of misunderstanding exists. It has been stated that the Chemical Foundation, Inc., is in it for all the money it can make. Nothing is further from the truth. In the first place every opportunity is given the licensee to assist in the fixing of the royalty to be paid. Often it is put right up to the applicant to name what to him seems to be a reasonable amount. The viewpoint of the Foundation in this respect is that they are anxious to see the various patents put to use and they are willing to make the royalty as low as possible in order to accomplish this.

Francis P. Garvan
President, Chemical Foundation, Inc.

It is difficult to mention any average figure which would be representative of the royalties paid as these differ widely according to the patent concerned. For example, an expensive piece of chemical machinery might be fixed at 10 per cent royalty, while on a certain dye, the production of which would be about 1,000 pounds per week, the royalty might be placed at 2 per cent. In addition no royalty is charged during experimental work, even though batches may be produced at this time. Royalties are based purely on actual cash sales so that possible bad debts are not assessed. Royalties are paid quarterly.

Licenses are non-exclusive. Once the royalty is fixed on a certain patent this amount is maintained for subsequent licensing of the same patent. The question of over production in certain commodities by reason of the number of licenses granted has been given much thought. After the Chemical Foundation has come to the conclusion based on its own investigations, that such commodity is produced in sufficient amount to meet the demands of the market, it notifies any succeeding applicant for license under the product of the situation. It then rests with the applicant, as to whether he will take the license or not. In some cases such succeeding licenses are taken, for the reason, that while the applicant fully appreciates the situation, he believes that it is necessary for him to manufacture the product in question himself, as his customers demand such product of his own manufacture, and he has a market already created because of customers he has acquired through his other products.

Research Work

The erroneousness of the idea that the Foundation is a money making organization is best shown by the fact that all profits are to be used for work which will advance the chemical industry in the United States. The nature of this work has not been definitely decided, but one plan is in a tentative form and may be mentioned. This would be research in the promotion of public health, a subject which affects not only the chemical industry but all industries.

Another misconception is that the larger dye firms monopolize the Foundation. As a matter of fact no more consideration is given them than the smaller ones. Licenses are granted impartially and royalties are fixed in the same way.

The Foundation controls a little under 700 dye patents. There are many for which licenses have not been granted. The reason for this is that the needs of the consuming industries required the dye manufacturers to concentrate at first on the great bulk of staple colors not covered by patents. For example, firms have been working on dyes such as auramine, Bismarck brown, methyl violet, etc., patents for which expired long ago. They have just recently been able to pay attention to the later dyestuffs and even on these the work has been largely experimental so far. As is well known, the manufacture of indanthrene colors is just about ready to reach the commercial stage. From now on more and more of these patents will be required by the dye makers.

The licensee holds the patent during its life. When it expires he no longer pays royalties, of course. In many cases a man receives licenses for several patents in connection with the manufacture of one product,—for example, in the production of soda. In this case he pays royalty on one patent only.

The Chemical Foundation, Inc., paid to the Alien Property Custodian the sum of $250,000 for the patents turned over to it. The remaining $250,000 of its capitalization was for working capital. This $500,000 was divided into 4,000 shares of preferred and 1,000 shares of common stock each with a par value of $100.

It was considered desirable from all standpoints to have the stock of the Foundation distributed as widely as possible. For that reason it was decided to plan the organization so that ultimately no stockholder should hold more than $1,000 worth of stock in the proportion of 8 shares preferred and 2 shares common. It will be realized that this aim could not be achieved immediately as it was necessary to secure the capital to purchase the patents and to conduct the organization. A number of prominent dye manufacturers, therefore, agreed to underwrite the Foundation for the amount desired, with the result that there have been stockholders possessing more than the prescribed $1,000 worth of stock. It is obvious that it was impossible suddenly to find 500 men who would purchase $1,000 worth immediately. Each of the dye manufacturers who subscribed to more than the original limit knew that this was merely for the sake of expediency and that sooner or later their stocks in excess of $1,000 worth each were to be turned over to the Foundation for wider distribution. More and more stockholders are becoming concerned in the Foundation and eventually the hope of allotment between the maximum number of holders will be realized.

The Shareholders

The only prerequisite for a man to be a shareholder in the Foundation is that he be all-American. It is, of course, deemed advisable that as many of these as possible be interested in the manufacture of dyes or chemicals.

The following statement from the charter of the Foundation best explains the broader function of the organization: "After the full redemption of the preferred stock, the net earnings of the corporation over and above such amounts as may be necessary for the purpose of working capital shall be used and devoted to the development and advancement of chemistry and allied sciences, in the useful arts and manufactures in the United States."

In this connection it may be noted that the Foundation intends to conduct a laboratory census of the United States by means of which a bureau of information can be established wherein a scientist engaged in research may be able to ascertain where the resources most necessary to him can be obtained and what progress has been made in similar branches of research. The importance of this aid to chemical research cannot be overestimated.

The officers of the Foundation are as follows: President, Francis P. Garvan, (Alien Property Custodian); vice-president, Col. Douglas I. McKay; treasurer and secretary, George J. Corbett. The legal advisers of the Foundation are the following: General counsel, Joseph H. Choate, Jr.; patent counsel, Ramsay Hoguet.

In conclusion it might be broadly stated that the greatest good arising from the Foundation has been the stabilization of the entire subject of patents. The improvement of the methods of the Foundation over the old licensing system of the Federal Trade Commission has contributed largely to the advancement of dye and chemical manufacturing in this country.

Cooperation Keynote of American Dyes Institute

Working for Best Good of New Domestic Industry

INSTEAD of tending toward monopoly as in the case of the German industry, the American dye industry has turned toward co-operation. There has been formed among manufacturers of dyestuffs and other coal tar products one of the most efficient and hard working associations noted among domestic industries. This is the American Dyes Institute, which was established in January, 1919, and grew out of a merger of two older associations, namely, the American Dyestuffs Manufacturers' Association, Inc., which was founded in April, 1918, and the old American Dyes Institute, which was also started during the war.

Briefly the object of the Institute was to promote and encourage the manufacture and use of American dyes; to co-operate with Congress, the Tariff Commission, the Federal Trade Commission and all Governmental agencies; to secure protection against unfair competitive methods by foreign producers who at the conclusion of the war may seek to destroy a new and necessary industry and again to monopolize the American market not only in dyestuffs, but in chemicals essential to national protection; for publicity in the transaction of business and the establishment of cordial and friendly relations among members; to co-operate with the Federal Trade Commission to expose and suppress unfair methods of competition; to devise a scientific system of cost accounting; to standardize as far as practicable so as to avoid wasteful duplication of production.

Procedure

It will thus be seen that the association stands for the correction of all evils which may crop up in the industry and for the promotion of all legislation which may act towards its best good.

There are no rules or regulations except such as the members may make themselves. The meetings are open. Officers are a president, elected annually; a board of governors, and an executive committee of that board, together with a treasurer and secretary.

Any corporation, firm or individual engaged in the manufacture of dyes or intermediates or kindred products in the United States is eligible to membership.

The members have monthly meetings. The executive committee meets frequently, sometimes two or three times a month; its activities are reported to its members at their monthly meeting. The board of governors meets whenever called together.

Committees

The program of work which the Institute has laid down for itself is so ambitious that it has been necessary to divide this among various committees of which the important ones are as follows: Accountants' Committee; Tariff Committee; Trade Committee; Standardization Committee; Legislative Committee; Educational Committee; Committee on Sanitation and Safety; Committee on Nomenclature, Spelling and Pronunciation; Committee on Instruction to Laundry People. There are of course a great number of special committees in addition to those named above.

It goes without saying that the Legislative Committee is by far the most important one. The most vital question facing the industry is whether or not the Government will grant it adequate protection to enable it to resist unscrupulous methods of competition on the part of foreign producers until such time as the domestic industry has attained its full growth. It is therefore but natural that an association made up of dyestuffs manufacturers should bend its energies toward securing this protection. This it has done in a hard, keen, open fight. Part of its efforts are outlined in the following excerpts from the report of the Legislative Committee at a recent meeting of the Institute:

"Your Committee, in presenting the case for the American dyes industry to the Committees of the House of Representatives and the Senate, proceeded upon the openly declared idea that the testimony of impartial witnesses at the hearings would abundantly establish the fact that an American dye and related coal tar chemical industry is absolutely essential to the national defense and national welfare, and that the existence of high tariff duties on foreign dyes and intermediates is not by any means enough to protect such an industry in the United States from destruction through foreign commercial attack during the temporary period when it is developing complete production for the country. In other words, your Committee proceeded upon the frank theory that a practical embargo against foreign dyes of the same kind and quality as those being produced commercially in the United States is a conceded necessity until our industry is fully developed.

"You are familiar with the testimony at the hearings, and, of course, know that it was established by the statements of military experts and chemists who have no connection with the dye manufacturers that a complete and self-sustaining dye and coal-tar chemical industry in the United States is a vital necessity for our national defense, national health and general industrial welfare. The completeness with which that truth was brought out is, we are entitled to believe, evidenced by the passage of the bill in the House of Representatives by a substantial majority, and by the favorable report of the amended Senate bill by the Finance Committee.

"Notwithstanding the pressure of legislative business in the Senate and the pendency of the Peace Treaty as a continual problem, the Senate by a very substantial majority vote took up the dyes bill for consideration with a view to its passage. With the urgent necessity for providing the necessary appropriations to operate the Government for the current fiscal year supplementing the Peace Treaty situation, those opposed to the legislation in the form in which it was reported by the Senate Committee were able to occupy a sufficient amount of time of the Senate, under existing rules, to make those in charge of the bill appreciate the impossibility of attempting to press the measure for passage.

"At the same time, your Committee is glad to be able to report that apparently a decided majority of the members of the Senate favor the passage of legislation to protect the American dye industry on the general plan embodied in the pending bill. The essential character of the industry as related to the national defense and national health seems to have been generally accepted, the vote for consideration above referred to clearly justifying such assertion by your Committee.

"In making this report it is eminently proper to state what the most of you know, that the great majority of the dye consumers of the country have been vigorously supporting the proposed legislation. These consumers have appreciated that both in the original 'license system' proposed by the manufacturers and adopted by the House, and in the 'qualified embargo' plan substituted by the Senate committee, adequate provision made for the consumers to secure from time to time all varieties of foreign dyes when the same kind or satisfactory substitutes are not made in this country.

"The attitude of your Committee has been, and in that it knows it has expressed the view of the dye industry, that the consumer must be given ample opportunity to have as full a variety of colors as the consumers of other countries. Co-operation between the manufacturer and the consumer is essential in the dye industry, and it is the Committee's view that a continuance of the recent co-operation may be looked for from the consumers who have heretofore supported the legislation necessary to develop our industry.

"For the information of those among you who are not familiar with the details of parliamentary procedure in the Congress of the United States, it can be stated that the adjournment of Congress on June 5 last did not operate to defeat the pending bill. It retains its status as a bill passed by the House of Representatives, reported with amendments by the Senate Finance Committee, and on the Senate calendar for consideration. In other words, it may be called up for final passage in the Senate at any time in the session of Congress beginning on the first Monday of December next.

"In the meantime it is, of course, known that the Congress provided an appropriation for the War Trade Board Section of the Department of State so that the dye consumers may import their necessary six months' supplies of dyes not yet made in the country, while at the same time the general importation of foreign dyes to injure or destroy the American producers may be effectively prevented."

Cost Accounting Methods

Another very vital activity of the Institute was the work of the Accountants' Committee which went thoroughly into the subject of uniform cost accounting methods for the dye industry. The work was undertaken particularly in connection with a review of costs by the U. S. Tariff Commission and the uniformity of method worked out by this committee was of inestimable value in aiding the Commission to complete its work. A report has been issued on the subject and further investigation is being carried on as the subject is one which permits of exhaustive research.

Officers

The first president of the American Dyes Institute was W. H. Cottingham, president of the Sherwin-Williams Company. The present president is R. C. Jeffcott of the Calco Chemical Company, Inc. The treasurer is H. E. Danner, 320 Broadway, New York, and the secretary William R. Corwine, 130 West 42d Street, New York.

The membership of the Institute is representative, and its activities promise to have a lasting good effect on the industry which it represents.

American Dyestuffs for the World

An Opportunity for Manufacturers to Ship Products to All Foreign Countries

By *Albert G. Rich*,
President Pioneer Dyestuff & Chemical Co., Inc.

AS probably almost all of the American public have now come to realize, the situation of the aniline and alizarine dye-stuffs has seen a complete reversal from the conditions existing before the war. Up to the time of the entrance of Germany into the world war, we knew of no other condition than that we were obliged to obtain, and were in fact, absolutely dependent upon other countries, mostly Germany, for our supply of dyestuffs necessary for the textile and other trades in this country. At the present time, this condition is completely reversed, for we are in the position today not only of manufacturing many coal tar dyes, but have actually sent them to practically every corner of the globe and have for some time been making regular and considerable shipments to most of the countries of the world.

This is a situation that certainly should make every American proud and naturally everything should be done to rightly conserve and increase this business. In order to do so it is vitally necessary to do business with our foreign friends in the way that they do business in contradistinction, perhaps, to the way in which we have been doing business in this country among ourselves. This is becoming increasingly apparent as some other nations are gradually endeavoring to obtain this foreign trade which we might almost say has been placed in our laps. We, at this time do not wish to dwell upon the matter of credits with foreign nations, although this is a most important factor in the matter of keeping our trade with many of them; nor in the small confines of this article will we dwell upon the peculiarities of the vari-

ous foreign countries; but we feel that we should emphasize the fact that the best results from our point of view will be obtained by the American manufacturer if he caters even more than in the past, to the particular methods of doing business by the various foreign nations to which he desires to send his goods regularly. For competition will naturally be very much keener in the future as other manufacturing countries are in a position to ship dyestuffs outside of their own country, and it does seem when the opportunity is now here and has actually presented itself, that we should at least make some slight effort, shall we say, to keep some of the trade which we now have. We venture the assertion that unless we do cater more particularly to our foreign friends in their methods of doing business we are liable to lose a large part of what we now possess in the line of a trade with practically all parts of the world.

American Market

In speaking, as we have above, of the world market for dyestuffs, we do not for a moment forget the importance of our own consuming domestic trade among the textile and many other trades that regularly use dyestuffs throughout our own country. From our above remarks we would not wish to imply that we have any thought of neglecting this home consuming market, but it is our pleasure now to emphasize the fact that today the dyestuffs manufactured in this country are being used by all of our foreign countries at least to some extent, and therefore it is our thought that the future of the American manufacturer in this country is most attractive, for he not only has the market for his products throughout the foreign countries but the domestic market is a large and increasing one, and also one that should not be neglected by any manufacturer. It is in this connection a much more stable market than the foreign one; for we can and do learn the exact requirements of our own domestic consumers, whereas we are naturally often handicapped, we might almost say at all times, in the foreign trade; for we cannot be conversant with the exact use and condition under which the products are to be used. We should endeavor for our own sake to increase our knowledge in this respect; our home market at our own doors is one that is known by those who have been in the dyestuffs business before the war, for many of them are very familiar with the actual mill conditions among the consumers of the dyes. We feel very strongly that our first duty is to take care of our home requirements and we think the message should be to each and every American dyestuff manufacturer that he should not neglect his home market.

Room for All

Just a word here perhaps should be spoken in reference to competition among the various American manufacturers. While we do not for a moment agree with the German methods, yet it must candidly be admitted that in reference to marketing dyestuffs before the war, there were some phases which admit of comparison and a lesson may be learned from them. Inasmuch as there are one thousand different coal tar dyestuffs not including even mixtures, it is readily apparent that there is plenty of room for all of the American manufacturers for many years to come. It is of course true that we naturally have made the simpler colors first, but inasmuch as there is plenty of opportunity for each and every individual manufacturer, care should be taken that the market is not spoiled, as it were, by the manufacturers competing on certain products with each other to the deteriment of all, both the consumer and the manufacturer. Because of the large number of individual dyes in prewar times, certain manufacturers abroad exchanged their various products. This had a most beneficial effect upon all, both from the manufacturers' and the consumers' standpoint, and this of course, obviated the duplication, to a great extent, of the manufacturing plants, and left each maker to go ahead and bend his best efforts on the production of dyes of the best quality and his best effort on the production of dyes of the best quality and at the proper cost. Should we not, therefore, learn a lesson from this?

Chemistry and the War*

By *Professor F. Francis, Ph. D., D. Sc., F. I. C.*

JUDGING from the exports of heavy chemicals from this country and Germany in 1913, we were in at least as good position as she was, but in the fine chemical industry Germany's position was immeasurably superior to ours. Taking the manufacture of dyes as a measure of this branch of chemical activity, we made £400,000 for an industry which required £2,000,000, and the annual value of this textile industry is generally stated to be about £200,000,000. Now Germany's export trade in dyes alone was worth £11,000,000 in 1913; she had specialized in that branch of the industry which required the maximum number of experts, the largest number of highly-trained chemists.

Even a brief consideration of the demands of the dye industry clearly indicates the very favorable position in which Germany found herself on the outbreak of war. This industry requires a very concentrated form of sulphuric acid, of which the amount manufactured in this country was practically nil. It required nitric acid, which we produced from Chili saltpetre, but which was manufactured in Germany from the air, and it required various coal tar products, such as benzene, toluene and carbolic acid. *Now all of these are equally necessary for the manufacture of high explosives.* Germany must have realized that she had set the world a chemical problem which she might reasonably have expected could never have been solved in time.

It is an easy matter to realize what the Allies, we in particular, had to accomplish, and it may be estimated from some data which have been published recently. On August 18th, 1918, at the commencement of the final push, we used 15,600 tons of ammunition; this rose to 24,000 tons on September 29th, when we broke through the Hindenburg line, and the estimated expenditure on a day of heavy fighting was £3,000,000.

Clearly we had solved the problem, although at a cost which we appreciate to-day. When we got to work, plants for the manufacture of concentrated sulphuric acid were erected rapidly in many parts of the country, and of these, that at Avonmouth was one of the most satisfactory. The actual method used had certainly been developed and perfected in Germany, but it originated many years ago in Bristol, and was discovered by a local vinegar merchant. At the end of the war we had become one of the large manufacturing nations of this form of acid.

Nitric Acid from Saltpetre

The nitric acid necessary we had to prepare from Chili saltpetre, of which the Allies exported towards the end of the war 500,000 tons more than Chili had ever previously exported to the world. The cost of this material rose from £11 a ton in 1913 to £27 a ton in 1917.

From this saltpetre we manufactured nitric acid at a cost of £30 a ton, and from this acid by interaction with ammonia, the valuable explosive ammonium nitrate at a cost of £60 a ton. This substance proved to be one of the most important of our explosives, and of it we made thirty times as much per week as we made in 1913. The ammonia required came from gas works, coke ovens, and Norwegian cyanamide. All the processes employed for its extraction were improved; naturally our export trade in ammonium sulphate stopped. It was valued at £4,400,000 in 1913.

Before the war our chief high explosive was lyddite, manufactured from carbolic acid and nitric acid by a process which does not require the concentrated sulphuric acid mentioned above, and at a cost of £200 a ton. But it was soon realized that there was not enough carbolic acid, or benzene from which it could be made, and it was necessary to manufacture another explosive. Consequently when the supply of concentrated sulphuric acid was sufficient, T. N. T. was made from toluene, an explosive which cannot be made without this form of acid. Again it was found that in spite of the improved methods adopted in all the gas works in this country there was not sufficient of this material, and it became necessary to fractionate out toluene from some of the native oils which came into this country. A large plant for the purpose was erected near Portbury in record time, and it is perhaps hardly realized that those imported oils played a great part in our final success. The toluene from these oils before 1914 had gone to the large dye works on the Rhine.

We had obtained Chili saltpetre from across the seas; we had increased our ammonia output by improved methods and by importing calcium cyanamide from Norway; now both saltpetre and ammonia are nitrogenous materials, and it is a matter of the greatest importance to consider how Germany obtained these essential substances.

Nitrogen from the Air

The importance of utilizing the nitrogen of the air for the preparation of these nitrogenous materials has been realized for long. At the Bristol meeting of the British Association, 1899, Sir W. Crooks stated: "The fixation of atmosphere nitrogen is one of the greatest discoveries awaiting the ingenuity of chemists. It is certainly deeply important in its practical bearing on the future welfare and happiness of the civilized races of mankind." Within a few years this problem had been solved, and without going into either the history of this question or the various methods employed, it will be sufficient to state here that up to 1913 the largest factories were situated in Norway, but in that year there had been perfected in Germany a new process due to Prof. Haber for the preparation of ammonia from the air, and it is doubtful whether Germany would have declared unless her experts were satisfied that this process was sound. By it 30,000 tons of ammonium sulphate were manufactured in 1913, which rose to 500,000 tons, with a plant capacity of 800,000 tons, in 1917. But Germany had other processes at work, also utilizing atmospheric nitrogen, and her total output in 1917 was 1,600,000 tons with a capacity of 2,000,000. Further, by the ingenuity of her chemists, she had perfected a process for the conversion of ammonia into nitric acid, utilizing for the purpose the oxygen of the air. The plant, amazing in its simplicity, requires the very minimum of labor to run it.

It appears probable that the cost of nitric acid made by this process is £15 a ton compared with our £30, and ammonium nitrate £22 compared with our £60 a ton.

Had this process been installed in this country we could have saved something like £6,000,000 per annum on the manufacture of ammonium nitrate, and what is still more important the valuable cargo space of the Chili saltpetre fleet. It was fortunate for this country that von Spee's squadron was sunk, and the coast of Chili free from danger. When the submarine menace was at its height, again the danger of a shortage of nitric acid was obvious. Investigations were at once commenced on the Haber process, and there were rumors of the erection of a plant costing many millions, but the menace faded, peace came, and the memory of England is short. America, it is stated, has put aside £20,000,000 in order to erect five such plants.

German Sources of Ammonia

At the present moment the ammonia future of Europe lies in Germany; the cheap production of fixed nitrogenous products from the air means that Germany is independent of the world for fertilizers, dyes, drugs and a dozen other things, and in time of war independent of the world for high explosives. She has the same sources of ammonia that we have, and in addition plant capable of producing 2,000,000 tons of sulphate per annum from the air at a pre-war value of £25,000,000, our exports of sulphate in 1913 were valued at £4,400,000. Germany exported in the same year £700,000, but what is it likely to amount to in the future when conditions in that country have again become stable?

The world's food supplies are dependent upon a supply of nitrogenous fertilizers to the soil, and the diversion of so large a portion of the fixed nitrates to the production of explosives during the war has been a serious matter. Each crop takes so much nitrogenous material out of the soil, and unless this is replaced artificially, the yield drops. Between 1890 and 1910 Germany increased the application of fertilizers from 1½ million tons to six millions, and in 191. she used double the amount per unit area that we did, with a result that the yield of cereals increased by 70%, and potatoes by 60%. Every 100 acres of cultivated land, arable and grass, gave 33 tons of corn against our 13 tons, gave 55 tons of potatons against our 11 tons, and supported 70-75 Germans against 45-50 English. Germany imported 10% of her food, we imported 60%.

(*Continued on page* 80)

* Address delivered before the Rotary Club of Bristol, England.

Addresses Delivered at Chemical Society Meeting

Sixtieth Gathering Productive of Many Valuable Papers

THE sixtieth annual meeting of the American Chemical Society, which was held at Chicago, from September 6 to 10, brought forth so many valuable papers that abstracts of certain of these are printed here.

The banquet of the Society was held on Thursday evening, September 10, and attended by more than 400 members and their guests. W. Lee Lewis, head of the Department of Chemistry at Northwestern University, was toastmaster on this occasion. The first speaker was Dr. Raymond F. Bacon, director of Mellon Institute of Pittsburgh. Dr. Bacon questioned that chemists had developed as yet as full a consciousness of their profession as lawyers and doctors have of theirs. He urged that they foster more of this real professional feeling among themselves and expressed the belief that they will advance even faster thereby than they have in the past. He remarked that he had lately been asked by three or four large concerns to recommend chemists to them for positions at salaries of $20,000 to $30,000 a year. The men to fill such positions are fewer than the demand for them, he said, and he urged all chemists to study the business side of matters, and become more rounded out so as to better qualify for such positions. In this way can the greatest help be given toward keeping America sold on chemistry.

Urges Protective Legislation

Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry* and former president of the Society, spoke very strongly on the subject of dye legislation, urging every one present to see their own senators and insist that they cease procrastinating and take action. He said:

"The tremendous progress of American chemical industries which characterized the war period has materially slackened during the past year, not because of any loss of zeal on the part of chemists, but because capital has grown timid. Without capital the work of the chemist can not be transformed into the economic independence of our country. This timidity of capital can be quickly overcome by one thing—effective protective legislation by Congress for those new chemical industries which our country needs during the early experimental years. The responsibility and the cure for the present situation lies with the United States Senate. Under its rules a very small minority has blocked progress. Obstructive tactics should be swept aside by that large majority of the Senate which clearly sees the welfare of the nation intimately bound up in the complete development of the chemical industries.

"Happily there is a brighter side to the picture as a result of this meeting in Chicago, for during the week the civilian chemists of the country have proffered their united services to the newly reorganized Chemical Warfare Service under the leadership of Brigadier General Fries. This cooperation will develop through a committee of twelve of the ablest members of our Society. To our country's service in gas warfare, both offense and defense, our organization stands pledged.

"But our energies are not to be confined to destructive agencies. There is a higher goal for our activities—the alleviation of human suffering. We have talked much about this and now I am happy to announce that, while details can not yet be given out, funds are in sight by which systematic research can be carried on through the cooperation of chemists, pharmacologists and biologists, which efforts we are confident will eventually bring comfort to every home in our land. America will lead in this beneficient work."

Team Work

Dr. William A. Noyes, president of the American Chemical Society and head of the department of chemistry at the University of Illinois, spoke on "Team Work." He said:

"We are all citizens and I cannot refrain from a word about some broader aspects of team-work in which we should have a part. We learned that we could not win the war until the nations were willing to unite under a supreme command. Some one has recently estimated that only one per cent of our national income is used for the direct benefit of our people in construction work through such agencies as the Department of Agriculture, Bureau of Mines, Bureau of Standards and similar agencies. Six per cent is used for the support of legislative, executive and judicial functions and the remaining ninety-three per cent is used for war, past, present and future. Has not the time come when the nations of the world may be willing to end that by team-work for mutual interests. The scientific men of the world have given us, during the last fifty years, such a control of the natural forces and resources of the world that we may easily give a reasonable livelihood to every one who will give a suitable return in productive labor. To secure that we must bring employers and employes together in working for their common interests and each must recognize the rights of that great public of which they are only a part. As scientific men we should use our forces on the side of cooperation and mutual helpfulness and against war, or ruinous competition between individuals or classes or nations."

The speaker gave an example of the value of cooperation and team work as shown by the tremendous growth of the American Chemical Society, which thirty years ago had a membership of only 256 and an income of $2,000 a year.

"Today," he continued, "we have more than 15,000 members and an annual income of $270,000. This is because we have united in our organization chemists of the most diverse character and interests—university men, industrial chemists, Government chemists—and have been willing to unite our energies harmoniously in working for the common good. During the last ten years, the growth of our Society has been very rapid, under the influence of our rapidly expanding journal, with the splendid leadership of our secretary in securing members and with the loyal support of our local sections, such as that of Chicago, which has more than 600 members, and our other sections scattered all over the country. With the assistance of every member we shall be carried forward into that new era, rapidly approaching, when American chemists will lead the world in manufacturing and research."

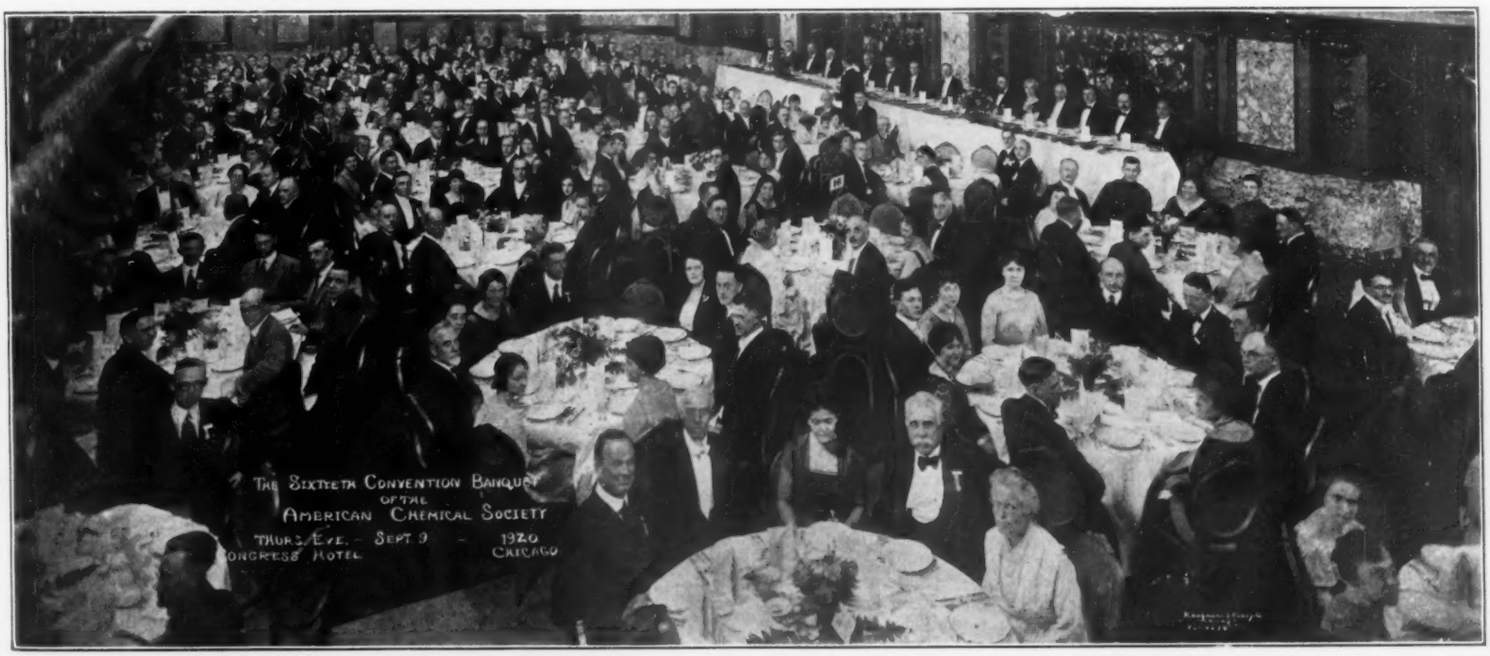
Tools of the Trade

Harrison E. Howe of the National Research Council and Secretary of the Industrial Division of the American Chemical Society in his address on "The Tools of the Trade" said that it was especially important at this time that the chemists of the future should be thoroughly trained by the University to work upon the many problems of research which must be solved in order that the production of industry could be increased.

It was also especially important in his view that the splendid work done by the manufacturers of American chemical apparatus should be increased.

Mr. Howe urged that every effort be made to publish at the earliest possible time tables of American constants to take the place of those printed in Germany. These tables are valuable tools of the chemist because they contain exact statements of the characteristics of various substances under different conditions and temperatures. These lists save an enormous amount of time which otherwise would be spent by chemists individually in making involved calculations.

William R. Moss, lawyer and member of the Chicago Association of Commerce, suggested that the chemists do not keep too much to themselves—shut up in their own laboratories—but get out and mingle with "the men on the street" and know the problems of man-



kind as a whole. He urged that all interest themselves in the problems of the day and thus help to retain for all humankind those three essentials of happiness and content—a home, a few friends and a job to furnish the wherewithal to keep up that home and entertain those few friends in a reasonable way.

The last speaker at the banquet, Mr. Otto Eisenschiml, consulting chemist of Chicago and prominent member of the Chicago section, expressed the pleasure which it had given the members of the Chicago section to entertain the out-of-town members and show them Chicago's points of interest and beauty.

Dye Division

The sessions of this division, which were held in the Physiology Lecture Room at the University of Chicago, were marked by increased attendance and were, of course, of greatest interest to textile manufacturers. Dr. Davis, chairman, opened the Thursday session with an announcement of the various papers to be read.

Dr. C. O. Johns, in charge of the Color Laboratory of the Bureau of Chemistry at Washington, spoke on the recent investigation on the re-classification of positions at Washington on which a report was recently submitted. He deplored the fact that the expert in productive chemical research work was not placed on the same salary plane as the executive and administrative chemist and told of efforts to have the Government and large manufacturing plants correct this. In the past the only way for a research man to get up to the really large salaries has been for him to work into the executive end. This condition has served to divert regularly from research work men who have proven themselves specially adept at it and should, Dr. Johns believes, be corrected by equal recognition so that the research and executive heads could go on side by side to greater accomplishment.

The present officers were elected to again guide the division for the coming year and on a motion by Dr. Charles L. Reese of the Dupont Co., ex-chairman of the Division, a vote of thanks was tendered them for their splendid service during the past year. The officers for next year are: Chairman, Dr. A. Brooking Davis, of the Cincinnati Chemical Works, Inc.; Vice Chairman, Dr. W. J. Hale of the Dow Chemical Co., and Secretary, R. Norris Shreve, consulting chemist, 43 Fifth Ave., New York. The present Executive Committee comprising the above officers and also Dr. F. B. Holmes of the Du Pont Co., and Dr. C. G. Derrick of the National Aniline & Chemical Co., Inc., was appointed by the Chair to serve again during the coming year.

New Napthalene Dyes

At the Wednesday session Dr. A. S. Wheeler of the University of North Carolina read a paper containing the following interesting remarks:

"These new naphthalene dyes color silk and wool directly in brown tones ranging from reddish to yellowish.

"These tones vary with the reaction of the bath and also may be modified considerably by the use of mordants. The sulphonation of naphthalene with fuming sulphuric acid is so regulated that the naphthalene 1, 5-disulfonic acid is obtained. This is fused with caustic soda and the resulting naphthol is oxidized with chronic acid to juglone. This hydroxynaphthoquinone yields a wide variety of halogen derivatives; additional products at low temperatures, and substitution products at high temperature. These are dyes since they contain both the chromophore and auxuchrome groups.

Both chlorine and bromine derivatives of juglone have been prepared. Tribromojuglone is obtained in yields of nearly 100% of the theoretical, is rich red in color while its sodium salt is indigo blue. The new work in this field includes the preparation of some others. Methyl ether, brick red crystals, its sodium salt being difficult to prepare; ethyl ether, yellowish red needles, its sodium salt being readily made. The influence of the alkyl radicles is to cause the dyes to become reddish in tone."

New Acid Processes

Dr. J. H. Carpenter of The Barrett Co. of New York read at the Wednesday session a paper on "The Application of Maleic and Fumaric Acids and their Salts in the Textile Industry." He said in part:

"These acids can now be manufactured on a large scale by the direct oxidation of benzol with air in the presence of a catalyst. Thus their possible production depends upon the supply of benzol available.

A. Brooking Davis
Chairman of Dye Division of American Chemical Society

"Maleic acid is important because it may serve as a basis for the manufacture of many hitherto rare compounds. The very fact that this discovery was made and developed in the United States should make it of special interest to our chemists and should stimulate efforts in finding commercial outlets for these acids. In this paper therefore I wish to primarily consider the possible applications of these two acids which are characterized as isomeric dicarboxylic to textile dyeing and finishing. This is a subject which to our knowledge has never been extensively investigated because these materials have not been available in commercial quantities.

"Actual applications of these acids and their acid salts have been made in the dyeing of woollens under the following divisions: Mordanting "assistant" for chroming of wools; for the development of color of acid dyes; for retarding the deposition of color in dyeing with such dyes as fast woollen cyanones.

Wool Printing

"Laboratory investigations have been undertaken with these acids and their salts and very interesting and encouraging results have been obtained.

"The above-mentioned investigations, give some very definite ideas as to where we can expect commercial outlets for these new acids and acid salts, but, on the other hand, it may readily be seen that promotion of these materials in the textile industry is a problem still in its infancy and that there is much more work to be done before any comprehensive outline can be given. The results gotten in their applications as mordanting "assistants" in the dyeing of woolens with chrome colors look especially encouraging, and we feel that there are some real possibilities for the use of these new materials. We will be glad to furnish samples of these acids to manufacturers who desire to make investigations of their own. We are also in a position to render some technical service and desire to do everything that is possible to stimulate investigations for the various uses of these different materials.

"It is desired to acknowledge especial indebtedness to Mr. A. E. Sampson, Chief Chemist of the Dye Application Laboratory of the National Aniline and Chemical Company, from whom many of these suggestions originated. Indebtedness should also be acknowledged to the representatives of the large textile concerns interviewed from whom some of this information was gotten and who made some of the investigations mentioned in this report."

Dr. Charles L. Reese
Former Chairman of Dye Division of American Chemical Society

Education of Research Chemist

Dr. Robert E. Rose of the Du Pont Co. addressed the Wednesday session as follows:

"The education of the men who are to lead the dye industry to future successes is a matter of vital interest to us. The subject is equally of interest, in its general aspects, to all who teach and to all who are concerned with commercial enterprises founded on the technical application of the results obtained by research.

"The dye industry in this country was established with the aid of research men who were not trained for this special line of work; they were men of general training and their adaptability to their new duties throws a very interesting light on the educational system of which they are the products.

"They were very successful, let that be emphasized, but at the same time let us study such faults as were apparent in order that we may learn how to improve the training given in our schools.

"The worst failings were a tendency to overlook trifling indications such as slight differences in color or structure or smell, and a disregard for the necessity for reasoning precisely and understanding clearly before doing any experiments, that is, there was a lack of exact observation coupled with rather vague reasoning.

"Of course, this was not true of the maturer men, but rather of those fresh from the training of the university. The causes of these faults lie very far back in our methods of teaching. Research is nothing strange; it is simply the use of the results of well trained powers of observation by a mind capable of clear reasoning. The child, who by the careful examination of a mechanism, learns how it works, is applying the methods of research. The chemist examines the substances of which the world is composed, finds how they are put together and learns how to make new ones. The essential of this kind of work is well trained senses, and the development of the senses is very largely determined during the years of early childhood. It is for this reason that we may say that the research man is made or marred during childhood and adolescence. However, we do not make a great effort to train the senses during childhood; instead we put a premium on developing the memory and formal methods of reasoning. Later in high school and university we continue to give the student too many second hand facts instead of making him observe for himself. We teach him to reverence the opinion of others rather than his own and thereby kill that healthy skepticism which is the essence of research.

"The courses in chemistry are apt to call for an exercise of memory rather than of reasoning, though they are better in this country than in any other. The future dye chemist is called upon to learn many formulas by eye without being given a good understanding of their real meaning. Finally, the research work in our universities is hampered by the routine duties placed on the teaching staff and therefore we find very few institutions which can be regarded as great schools of research where many men learn from each other the enthusiasm of the true investigator. We are too apt to regard research as fulfilling, in part, the requirements for the degree of Doctor of Philosophy, instead of adding to the sum of human knowledge.

"The remedies are easy to state but hard to apply—the teaching of observation, the training of the senses can be done properly only by really efficient grade school teachers, with the co-operation of parents. Some day we shall recognize the fact that the school teacher is of more importance to our supply of research men than is the college professor. Some day we shall admit that schooling, though intangible, is worth more than railroads, mills, and all other material things save only food and that it is worth paying for. Then we shall have better dye chemists.

"In the high schools and universities, we need a higher average of excellence in the teaching staffs—there are very many extremely able men, but there are also many unambitious, rote teachers who teach because they find it easier to do that than anything else, men who are never up-to-date. We need better text-books, especially of organic chemistry—we have nothing in this line which is in keeping with the modern development of applied organic chemistry. I do not mean technology, but a text giving due emphasis to the applications made of knowledge expressed in the facts and theories of the class room.

"To foster pure research we should have institutions set aside for research, institutions to develop, as the years pass, into great schools wherein the advance of the science will be aided by all the resources of the nation.

"The teaching of research is a subject of interest to all, because the measure of the success of a nation is the quality and number of her trained specialists. It is of special interest to us because the industry to which we are devoted needs, more than any other, a great number of capable research men. It is for that reason I address this paper to the Dye Section of the American Chemical Society."

Training of Chemist

The following statement was made to the Thursday session by Dr. M. L. Crossley of the Calco Chemical Co. of Bound Brook, N. J.:

"I am of the opinion, that in addition to the training which a man receives fitting him as a chemist, he should also have a definite amount of experience before he is considered a chemist to qualify as such and should have a university training or its equivalent in the fundamentals of chemistry, physics, and mathematics, and in addition have had at least five years' experience in a research laboratory connected with either the university or an industry. This can best be accomplished by appointing men who have just been graduated as junior chemists to be advanced to assistant chemist after two years of satisfactory work under the direction of senior chemists. From the assistant grade appointment should be made as a chemist after satisfactory evidence has been given by assistant chemist of his ability to understand and appreciate the responsibility to his profession in rendering efficient and accurate service. The title of chemist should carry with it distinction and should not be lightly given to men whose qualifications do not fit them for the kind of service which the chemist should render in his profession."

Standard Laboratory Equipment

At the Thursday session the following paper was presented jointly by C. V. Ogilvie, G. S. Simpson and M. L. Crossley:

"In order to secure accuracy and efficient results in analysis in organic research laboratories, it is imperative that we use standard equipment in which the factor of equipment error is reduced to a minimum. We propose two such pieces of standard equipment for laboratory purposes, first, a diazotization burette. This is a jacketed burette which can be cooled to any desired temperature by circulating brine and which can be used for diazo solutions easily decomposed by light. The burette is similar to a condenser of the shell-back type, having a blue line on a white background. The lower end of this burette should be made of capillary tubing so that only a small volume of solution is held in this portion of the burette. The burette is sealed in a condenser tubing, care being taken to avoid an exposure of much of the burette surface. The inlet and outlet tubes for circulating the brine solution through the jacket are so placed as to allow the water to surround the entire burette. It is protected from the direct rays of the light by standing the jacket, leaving only sufficient exposed surface of the jacket to enable the operator to read the volume of the solution. The same thing can be accomplished by using a colored solution for cooling the jacket.

Several different arrangements have been tried for circulating the brine solution. The most satisfactory are the following type: A tank containing ice, salt and brine is placed upon a platform above the burette. The water from this tank runs into the jacket of the burette by gravity and overflows from the top into a pipe from which it returns to the original tank. It is lifted and circulated by means of a small centrifugal pump. By this means it is possible to cool the solution to minus five degrees C. and maintain at this temperature throughout the diazotization. This is of the utmost importance for accurate results in the analysis of many dyes and intermediates analyzed by this method require that the apparatus shall be capable of the smallest possible errors due to the fact of external conditions on the solutions used. Since diazo solution is easily decomposed under the influence of both light and heat, this burette enables one to exclude both of these factors, makes possible accurate analysis and prevents errors due to the influence of traces of by-products which would otherwise be formed and change the color of the diazo solution, thus making it difficult to evaluate the results.

"Second, a standard stirring equipment for use with volatile liquids. We propose laboratory stirring equipment to be used for either the extraction or mixing of volatile liquids consisting of a wide mouth flask fitted with thermometer and glass stirrer driven by a shaft which extends through a condenser. This vertical shaft is driven from a 1-inch horizontal shaft 36 inches above the bench. The vertical shaft is supported from the wall by iron bearings and placed 7 inches from the horizontal shaft. By proper adjustment of the driving pulleys one can carry on stirring at different heights from the operating bench. The bearings are of glass and the pulleys of wood. The pulleys have three speeds and are driven by ⅛-inch leather belting. This type of equipment does away with the necessity of mercury seal which is usually necessary in work of this kind and which frequently contaminates the reaction mass."

Urges Protection for Dyes

Protection for American dyes against the inroads of German competition was urged by Mrs. Glenola B. Rose in an address before the women members of the American Chemical Society at the Friday session.

Mrs. Rose who has had a varied experience with the Dyestuff Sales Department of E. I. du Port de Nemours & Co., of Wilmington, Delaware, described the efforts which are being made by the dye manufacturers under the prevailing conditions. She declared that they were fully able to produce as good dyes as were ever made in Germany.

"At the last meeting of the American Chemical Society held in St. Louis," said she, "the chemists were requested not only to get the companies for whom they worked to write to the Senators of their State, but to write to them themselves, requesting that they support the passage of the dyestuff bill.

"This bill will come up before the Senate again in December. Briefly, the story is this:

"Because the dyestuff industry in America has spent millions of dollars to get started and is not yet well enough established to be able to withstand unlimited competition, it is requested that a bill be passed that for a period of years not to exceed three years after the passage of the bill there shall be an embargo on the importation of all dyes into the United States. When necessary, however, because of a production in this country insufficient to supply the demands of the nation, or the price at which the supply is offered is too high, or when the product is of too poor a grade to be used, foreign made products will be allowed to enter to supply the deficiency, with a proper tariff.

"This seems fair enough in view of the unfair practices which were adopted by the Germans, in years past, to stifle any attempt at the development of this industry. In view of the amount of money and effort expended by the manufacturers of our country the short period of three years is very small, indeed.

"And so at this meeting it is my privilege to request you to write to your senator expressing your opinion on the dyestuff bill, because from now on our opinion is to be worth something, and there is need of an expression of opinion because we for many reasons want an American Dyestuff Industry.

"Now, having told you something of the manufacture and application of dyes and our desire for proper legislation, you will ask, "Why, if American dyes are identical with German dyes, is it necessary to have an American Dyestuff Industry?" Every American is independent enough to say that he wants America to be self-contained if at all possible. But there are other reasons than this. A country possessing a well developed dyestuff industry, is constantly supplied with trained men, plants and materials suitable for immediate diversion to the manufacture of explosives and poison gases.

"And finally we have today in America probably the finest group of young chemists in the world. In our industries we have men acquainted with the research chemists of the industries of Europe, and they frequently remark about the superiority of the young American chemist. We are proud of our chemists, so proud that we believe the advance in science will be greater if they participate in the new research problems which unfold as old ones are solved. Nowhere is offered such opportunities for research as in the dyestuff industry, which requires a constant and a large supply of technically and scientifically trained man, and its sister industry of pharmaceuticals and therapeutics. We will be able to have a greater beauty with which to surround our lives, better weapons to fight the invisible, treacherous war which we have always with us, disease, if our chemists, too, study toward these ends in greater number and with greater intensity."

R. Norris Shreve
Sec'y Dye Division, A. C. S.
(Photo by Murillo)

W. A. Noyes
President American Chemical Society

Dye Division of American Chemical Society

An Open Forum for the Discussion of the Problems of the Dye Chemist

By *R. Norris Shreve*, Secretary of the Division

THE thoughts that I had in mind when I first spoke to Dr. C. L. Parsons about the advisability of the formation of a Dye Division of the American Chemical Society, were first to afford a means for those chemists interested and working in the fast developing dye industry to gather together for mutual acquaintance and for discussion of their chemical discoveries and problems; and second to effect this organization of dye chemists within the fold of the American Chemical Society. One of the outstanding advantages of American chemical endeavor is that most of the chemists of whatever varied specialization and bound together in the one large society, within which they divide up for the detailed discussion of their own particular problems, as, for example, the American electro-chemists.

Turning back now to the origin of the Dye Division, when I first broached the subject, some doubt was naturally felt as to how such a move would be supported, and in conformance with the wise policy of the American Chemical Society, Dr. Parsons said to first hold a "Dye Symposium." This was in the summer of 1918 while the war was in a very critical stage, and while all of us were busy with America's part. Dr. Parsons, however, thought that the time was ripe, and accordingly I arranged the Dye Symposium—which was held in

(Continued on page 81)

Representative Dyestuff and Chemical Manufacturers

Historical Sketches and Products Made by Prominent Companies

IN a certain sense, the story of each individual firm which has been active in the manufacture of dyestuffs and chemicals is the story of the American dyestuff and chemical industries in general. The same obstacles which had to be overcome in establishing a self contained industry in this country have been met to a greater or less degree by each particular firm. Nevertheless there are individual conditions in each case which make the stories of the various companies varied and interesting. Furthermore, there has been a great deal of specialization, and companies have in probably the majority of cases, emphasized the production of one or more particular groups of products.

In order to complete a review of the development of this important industry, historical sketches of many of the important concerns engaged in the manufacture of dyestuffs and chemicals are given below. The descriptions do not cover all the plants engaged. In many cases, the companies are undergoing processes of organization and do not feel that the time is ripe for public announcement of their plans. For other reasons, certain firms did not care to make a statement regarding their history. An attempt was made to interview or write all the concerns at present interested in this industry. If any were overlooked it was certainly not intentional but was due to the absence of a new and revised official list relating to dyestuff and chemical manufacturers.

It will be noted that the majority of the descriptions refer to dyestuff plants. This is not because the chemical end is any less important but because, as noted elsewhere in this issue, development in the dyestuff branch has been more closely concentrated within the past five years, and this is the period which is being reviewed. It must be emphasized again, that the progress in both branches is closely related and credit for the advancement of the domestic industry is shared jointly by both.

The following descriptions cover what may be considered representative organizations engaged in dyestuff and chemical manufacture:

Althouse Chemical Company

A TYPICAL example of the results secured by American perseverance and ingenuity is that offered by the Althouse Chemical Company, 500-540 Pear street, Reading, Pa. At the outbreak of the war, when the shortage of dyestuffs was confronting the industries with the threatened curtailment of operations because of the exhaustion of all visible supplies of imported colors, the members of this company, C. Scott Althouse and N. S. Althouse, were among the first to take up the arduous task of developing and building up a dye producing business from the very ground. At that time, it was impossible to secure the equipment required for many of the delicate and refined processes involved. Many of the chemical formulæ and processes of manufacture were either vaguely known, or not known at all. To overcome such enormous obstacles required a perseverance and a confidence which refused to admit defeat. It necessitated a persistent effort and a large amount of capital for experimentation and research work before success was finally attained.

It was in the month of September, 1915, that the Althouse Chemical Co. first began producing colors on a commercial basis. Their sulphur black met with ready success. The first development in their manufacture of colors was the successful discovery of a very good process for making benzidine. Their success in making this important base for the manufacture of direct colors enabled them therefore to begin the manufacture of these dyes on a large scale. The first direct colors developed by them were the yellows and the reds, and as time went on, the experimental and research work in their laboratories succeeded in producing other direct colors until today they are manufacturing a complete line of direct colors and also union colors. Their equipment for type colors now has a producing capacity of 8,000 pounds per week. They have discontinued the manufacture of sulphur black and are now devoting their entire energy to the production of these direct colors as well as union colors. While they have also developed several acid colors in their research laboratory, they have never started the manufacture of these colors on a large scale for the trade. Their product is entirely textile in its uses. Their dyestuffs are sold not only in the textile districts of the United States but are also sent abroad to foreign countries, as they have built up a very satisfactory export trade in their products.

Other Intermediates

After the successful manufacture of benzidine, the Althouse Chemical Co. took up the development of other coal tar intermediates for the making of dyestuffs. As a result of their accomplishments in this direction, they are now making practically all of the intermediates used in their plant for the development of dyestuffs.

In view of the fact that it was necessary for the company to develop their methods and formulæ for the making of these textile colors, they have at present a most completely equipped laboratory for experimental and research work in the development and perfecting of their products. Not only that, but because of the complete absence of any known source of supply for the mechanical equipment required for the various processes involved, it was necessary for them to develop and erect their own machinery and equipment needed in their work. This of necessity demanded patient and persistent effort, and credit is due C. Scott Althouse of this company for the manner in which he persevered in his task of unearthing the secrets of the dye making, and in developing the organization which today helps to substantiate the claim that American made dyes can be and are as good as any in the world.

In the laboratories of the company are to be found every possible device and equipment required in the delicate and refined work of chemical research in developing dyestuffs. This equipment is most complete and includes even an ultra ray machine for testing fastness of colors which has been found most useful in perfecting their formulæ. In this laboratory, trained chemists are always at work, and at present are engaged in the development of a number of new colors which it is expected will soon be offered to the industry.

Manufacturing Plant

The manufacturing plant of the company is likewise developed along every possible line looking to the completion of each step involved in the production of dyes from the coal tar bases, through the intermediate stage into the final form of direct and union colors. Their present capacity is 8,000 lbs. of type colors.

The American Dyewood Company

SINCE the outbreak of the war the greatest interest among consumers of dyestuffs throughout the country has naturally centered in the development of an American aniline dyestuff industry—this because of the complete cessation of importations from Germany which had been previously almost the sole source of supply. Great as interest in the coal-tar dye industry may be, it must not be overlooked that natural dyestuffs—chiefly logwood products—have long been produced in this country and, in fact, that this particular branch of the dyestuff industry has long since reached a state of perfection in America not exceeded elsewhere in the world.

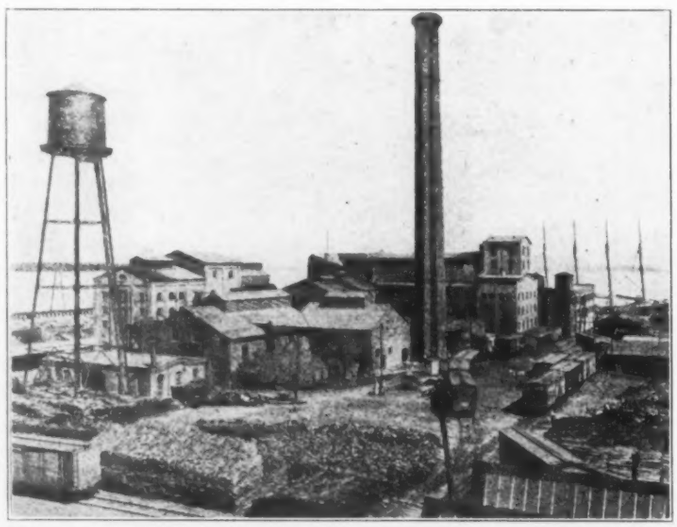
As a matter of fact, it is unquestionably due to the existence of this native American industry that a great many of the textile mills were able to continue in operation during the period following the outbreak of the war when stocks of German colors in this country had become practically exhausted and before the American manufacturers of aniline colors had been able to develop the necessary plants to supply consumer wants.

The American Dyewood Company was incorporated in 1904, combining, as its name would indicate, the more important of the earlier existing American concerns manufacturing dyewoods. The history of these earlier concerns goes back to Revolutionary days.

First Dyewood Mill

The manufacture of dyewoods in America may be said to have started in New York with the pioneer predecessor of the American Dyewood Company, William Partridge, an English dyer. He founded in 1798, at Greenwich Village, a suburb of New York, now about West Tenth Street, the first dyewood mill in America. The power was furnished by a horse walking around a capstan. This device operated a small cutter provided with saw-tooth knives. The chips produced were treated to develop the coloring principle of the wood and the manufactured ware proved in every respect equal to the dyewoods then used in England.

The Greenwich Village Mill becoming inadequate to supply the demands for its products, Mr. Partridge removed his factory to Gravesend, back of Coney Island, where, by means of a wheel and with the utilization of the tide-water for power, larger works could be operated. In 1868 the rapidly increasing business necessitated better facilities, and the establishment was moved to Greenpoint, Brooklyn; and in 1872, the business was incorporated as the New York Dyewood Extract and Chemical Company.



Riverside Mill of American Dyewood Co. at Chester, Pa.

During this development in and about New York, other dyewood mills were coming into being in America. In 1844 a dyewood mill was started at East Boston by William P. Porter; in 1869 it was consolidated with other dyewood concerns dating from about the same period and incorporated as the Boston Dyewood and Chemical Company. In 1892 the Boston Dyewood and Chemical Company was consolidated with the New York Dyewood Extract and Chemical Company; in this consolidation was also included the Atlantic Dyewood Company which had been organized some ten years previously. The name of the new corporation was the New York and Boston Dyewood Company, and its dyestuff business was consolidated with the Sharpless Dyewood Extract Company of Pennsylvania, in 1904, as the American Dyewood Company.

Sharpless Plant

Of special interest as the direct predecessor of the present manufacturing plant of the American Dyewood Company are the dyewood mills that were operated in the vicinity of Philadelphia. In 1835, John M. Sharpless erected a mill for cutting dyewoods at Waterville, near Chester, Pa. The works originally were operated by water-power only. The problem of conveying the wood from the wharf in Chester to Waterville was solved by building enormous wagons, with wide tires, drawn by tandem strings of six horses.

In 1895 the business was incorporated as the Sharpless Dyewood Extract Company. The growth and increase of the dyewood industry after 1850 and the necessity for quicker transportation facilities led John M. Sharpless & Co. to remove their works from Waterville and to purchase a tract of land at Chester, Pa., on the Delaware River, where they erected the considerable plant since known as Riverside Mills. The mills were fitted with the most advanced machinery, the installation being completed in 1879. Situated directly on navigable water, served by two or three lines of railroads, and possessing every facility for the landing of raw materials and the shipment of finished products, this company enjoyed increasing success for a quarter of a century.

American Dyewood Co. Formed

In 1904, the dyestuff business of the Sharpless Dyewood Extract Company and that of the New York and Boston Dyewood Company were sold to the newly founded American Dyewood Company, a Pennsylvania corporation.

The combination of resources thus effected gave immediate impulse to the growth and progress of the dyewood industry. Within a year it became evident that the Riverside Mills offered better facilities for producing and distributing dyewoods than the other mills of the company and the manufacture of natural dyewood extracts and products was rapidly concentrated at Chester. This concentration involved a doubling of the capacity of the works to meet a corresponding increase in the company's business and further increases in capacity and output have since been made.

The numerous symmetrical and substantial buildings of the Riverside Mills cover a large area of ground with a frontage of 690 feet on the Delaware River. The situation insures an abundant supply of pure water and all the advantages of a tide-water location and there are docking facilities to accommodate the largest vessels in the West Indian and Mexican trade. Most of the vessels docking at the company's pier come from the West Indies, particularly from Haiti and Jamaica; some are from Mexican or Central American ports; a few are coastwise vessels from New York and elsewhere.

The American Dyewood Company, through its subsidiary company, the Compagnie Haitienne, controls large tracts in Haiti, on which are virgin forests of logwood, and through this subsidiary it operates an overhead tramway from these forests to Port de Paix on the northern coast of Haiti for the transportation of logwood in the stick.

The products of the American Dyewood Company might be classified in the following way:

For Cotton dyeing:
- Logwood Extracts and Crystals
- Fustic Extracts and Crystals
- Bark Extracts
- Cutch Extract

For Wool dyeing:
- Hematine Extracts and Crystals
- Fustic Extracts and Crystals
- Bark Extracts
- Hypernic Extracts and Crystals

For Silk dyeing and weighing:
- Logwood Extracts and Crystals
- Hematine Extracts and Crystals
- Fustic Extracts and Crystals
- Gambier
- Cutch Extract

In order to make it possible for users of these products to secure the satisfactory results which they seek, the American Dyewood Company has available for their use, a group of experts to give advice as to the proper application of these products.

Anthrakone Dye Products & Chem. Co., Inc.

THE Anthrakone Dye Products & Chemicals Co. has been in existence about two and a half years. The concern was originally the Globe Chemical Company of New Jersey. The company was reorganized in August, 1919. The present company, headed by Irwin Arnow, the president was formed for the purpose of increasing the capacity and procuring a much larger output of anthracene products. The Anthrakone Dye Products & Chemicals Co., Inc., are manufacturers of anthraquinone and derivative vat dyes. Their factory, covering four and a half acres, is at Kenilworth, N. J. The selling office, of which Mr. Arnow is in charge, is located at 1834 Broadway, New York.

The company now has a minimum capacity of 2 tons of anthraquinone a week. In the factory of the Globe Chemical Co., which was located in Jersey City, no such quantity of output could be attained. As the need of anthraquinone for vat colors has been one of the most pressing in the period since the war, the company found it must have larger quarters at once.

Plants Enlarged

Upon the reorganization and expansion of the company in 1919, steps were taken at once to procure a larger plant. The company was successful in obtaining the plant which they now occupy at Kenilworth. N. J. Occupation could not be made at once because of the delays in building, repairs and the installation of equipment. The removal from the smaller quarters in Jersey City to the plant at Kenilworth was finally accomplished in March of this year. The Kenilworth plant is located on a plot four and a half acres in extent. Here the company occupies a two story building 50 x 270 feet in dimension. There are also out buildings approximately 50 x 50 feet. This factory site was formerly occupied by the American Chicle Company. Before occupied by the present company it was also used by the American Reclaiming and Refining Co.

Products

The success of the company in attaining a large quantity output of anthraquinone is one of its proudest achievements. The company claims for its product a purity of 98 to 100 per cent. The company also manufactures carbazol and phenanthrine. Carbazol is used in the manufacture of hydron blue, a very fast color that is applied largely in the dyeing of cottons — particularly denims. In view of the overall movement, the demand in this particular in the past year is said to have been most gratifying.

Phenanthrine has been in much demand in the paper industry for sizing. It is also used in manufacturing shoe blacking and is said to form an excellent substitute for waxes employed in other industries.

On account of difficulty encountered in recent years of obtaining crude anthracene of a substantial content the price of anthraquinone, it is explained, has necessarily had to be high. The present company has succeeded in making connections for obtaining crude anthracene of a high anthracene content and in sufficient quantities to enable it to operate at top capacity. This is really 50 per cent more than its minimum capacity. According to Mr. Arnow, the company expects in the near future to offer anthraquinone at a sufficiently low price to encourage dye makers to go more extensively into lines of vat colors. In the event of the favorable turns in the market that there is every reason to expect, the price of anthraquinone need not exceed $2.75 as against the present price of $4.00 per pound. In this connection Mr. Arnow explained that many smaller concerns have been held back by prices that might almost be considered prohibitive, and it is in itself an evidence of progress that is being made in this branch of the dye industry.

Anthraquinone is also used for calico printing as a discharge agent. The process employed in calico printing is an intricate one and seems to be a secret one, and it is known only to a very few.

The Atlantic Dyestuff Company

ON Christmas Day, 1916, the Atlantic Dyestuff Company produced its first batch of finished dyestuff.

Started for the purpose of helping to solve the dyestuff crisis brought on by the shutting off of foreign-made colors, incident to the war, the progress of this company has been steady, without being spectacular.

In the beginning the Atlantic made only sulphur blacks; from time to time the manufacture of other colors was taken up until by the time the armistice was signed it was making in quantity a number of dyes needed in the production of army fabrics, especially sulphur black, sulphur blue, sulphur khaki and chrome yellow.

Early in the spring of 1919 a disastrous fire virtually destroyed its manufacturing plant at Burrage, Mass., fortunately, however, not damaging to any extent a large stock of finished dyestuffs.

Up to this time the Atlantic Company's sales had been handled by agents. Its success, coupled with the constant demand for its products, seemed to justify the rebuilding of its burned plant; meanwhile a sales force had been organized for the purpose of selling its products direct to the consumer.

Hardly was the work of rebuilding under way at Burrage before the company had made long-time contracts, which justified the building of an extensive and substantial plant at a point possessing the maximum of facilities for a dye and chemical works. As a result the L. H. Shattuck Shipyard of the Emergency Fleet Corporation, located on the Piscataqua River, at Newington, just north of Portsmouth, New Hampshire, was purchased in the latter part of 1919 as the site of its new works.

The photograph of these works herewith, taken in July of this year, gives a clear conception of the progress that has been made toward the building of an extensive plant, as well as the substantial class of construction going up.

It is not amiss to say that the Atlantic Company's investment at Portsmouth is an earnest of the confidence of its owners in the Government's attitude toward the protection of this—a key industry.

Forty Distinct Products

To-day the Atlantic Dyestuff Company is producing forty distinct dyestuffs, chemicals and intermediates; these comprise some thirty dyestuffs, including sulphur black, sulphur blue, sulphur brown, sulphur yellow, direct black, direct blue, direct brown, direct green, direct red, direct yellow, acid black, acid red, chrome yellow, developed black.

The Atlantic Company makes about fifteen intermediates, mostly nitration products of benzol and toluol; in addition it produces a few special chemicals used in the textile and allied industries.

The extent of its production of sulphur colors may be measured by the fact that it has produced in one month 660,000 pounds of these colors, and 350,000 pounds of intermediates, in addition to moderate quantities of other dyes, and chemical specialties. Its total capacity for making finished products to-day is, including dyestuffs, intermediates and chemicals, somewhat over 18,000,000 pounds per year, and inside of a month will be increased to about 30,000,000 pounds per year.

In due course its plant at Burrage will be dismantled, and all manufacturing centered at Portsmouth, where the layout and installation contemplate large scale production at a minimum cost.

Description of Plant

The buildings being erected by the Atlantic are of fireproof construction, the columns being of reinforced concrete, veneered with brick, while the intervening space is filled in with inter-

locking hollow-tile. Roofs are either monitor or sawtooth. Every building is amply removed from every other one for the purposes of providing abundant light and fire protection. Perfect drainage is provided in every building; concrete ground floors are used throughout, wood being used only to a very limited extent. In fact the factors of light, ventilation, safety and perfect working conditions have had first consideration in all plans.

The present plant of the Atlantic Company at Portsmouth may be divided into two groups—the non-productive and productive buildings. The non-productive comprise office, accommodating sixty people; hotel and restaurant, capable of housing 100 men, and providing meals for upwards of 1,000; storage building, measuring 300 x 125 feet, containing fully equipped carpenter, machine, pipe fitters' and blacksmith shops—these enable the company to do practically all of its wood work, and a large amount of its sheet and other metal work in connection with the installations being erected; power plant of 1,000 horse power capacity, with room available for 2,000 boiler horse power, housed in a steel building; in addition to the other installation in this building, two ice making machines have been put in, also two compressors, one steam driven and the other electrically driven; power house, located on river bank convenient to water for condensers; pump house containing two electrically driven centrifugals, used for circulating salt water for cooling purposes, with a capacity of 1,800 gallons per minute, and one steam driven pump of a capacity of 1,000 gallons per minute, to provide fire protection. Pumps are interconnected so that any one or more can be used in case of trouble with the others.

Manufacturing Buildings

The group of manufacturing buildings consists of two separate nitration buildings, in one of which is installed two nitrators, and in the other one Hough nitrator. The makers of the Hough claim this to be the largest nitrator ever made, it having a capacity of 50,000 pounds daily of TNT; it will be used chiefly in the manufacture of dinitrichlorbenzol; still house of ample dimensions and containing two large Badger stills; reduction building in which are installed two reducers and two more will be added shortly; sulphur blue unit, consisting of three connecting buildings, with a monthly capacity of 60,000 pounds of finished colors. Acid mixing and acid recovery plants, and sulphur black unit consisting of four connecting buildings, are now being erected.

Plant equipment consists of one standard gauge engine, one moving crane, and 10 cars, which may be used at any point on the property, on account of the splendid railway system.

Plant of Butterworth-Judson Corporation

Plans now matured by the Atlantic Company contemplate the expenditure of several million dollars at Portsmouth, which seems to be justified in view of the fact that this company's business in volume ranks high among the dyestuff manufacturers in America.

The Atlantic Company has specialized from the first, and will continue as specialists in the future. This is a fixed part of its policy, its management believing that not only its welfare, but the welfare of the American dyestuff industry as a whole, rests upon the policy of specialization by its various members.

Atlas Color Works, Inc.

THE plant of the Atlas Color Works, Inc., is located at Hamilton Ave., Brooklyn, N. Y. The offices of the company are at 322 Ninth Street, Brooklyn.

The following dyestuffs are manufactured at the plant of the Atlas Color Works, Inc.:

Indigotine, natural and synthetic.
Indigo extract, natural and synthetic.
Indigo paste.
Methylene blue.

Butterworth-Judson Corporation

THE start of the present organization of Butterworth-Judson Corporation was made when James Butterworth and Egbert Judson commenced business as Butterworth & Judson. The deeds of the land and water front of part of the property now known as Plant "A" were drawn in 1882 and 1883. At that time they specialized in making nitric acid and tin crystals, adding a few other chemicals from time to time.

They were incorporated as Butterworth-Judson Company in 1901 and continued under that title until the present organization called the Butterworth-Judson Corporation, which was organized the latter part of December, 1915, took over the Butterworth-Judson Company, who at that time had a small acid plant at Newark, N. J., and the American Symthetic Dyes, Inc., who had the nucleus of a picric acid plant in the same locality.

At this period the above two companies employed about 350 or 400 men, which gradually increased until between 3500 and 4000 men were employed during 1917 and 1918.

The Butterworth-Judson Corporation had developed into one of the largest producers of picric acid and ammonium picrate in the country, their location being ideal for a large chemical plant; that is, ready access to the labor market, on tide water, and with good rail transportation, in addition to being in close proximity to the port of New York.

The company found out very quickly the necessity for enormous quantities of sulphuric and nitric acids, and one of the chemical plants erected in seventy days from the time the first pile was driven until sulphur was burning in the furnaces constitutes a record in the matter of war-time construction.

At the close of the war the corporation had just completed and started to operate a new picric acid unit, which was designed to produce sixty tons a day, but before they were able to operate this unit to its full capacity, the armistice was declared and they did not have the opportunity of demonstrating the enormous capacity of this unit.

Since the suspension of war activities the company has developed the process of manufacture and accomplished the production of a marketable quantity of at least sixteen standard and accepted dyestuffs.

It has been the practice of the company to make dyes that are more difficult to produce, and in this way they have built up a name in the textile field that is highly valued. The present plans include some of the colors that were heretofore considered beyond the scope of the American manufacturer.

In addition to dyestuffs, the company has developed a number of intermediates, namely: H acid, paranitraniline, gamma acid, 1:2:4 acid, picric acid, G-salt, R-salt, acetanilid, and aniline oil. All of these products are now manufactured with the exception of gamma acid, which the company expects to offer to the trade in a very short while.

Calco Chemical Company

THE Calco Chemical Company began the production of intermediates in June, 1915. They started with aniline oil and soon added aniline salt and beta naphthol to their list. At first they merely supplied these intermediates to the trade, but as the dyestuff stringency was then at its most critical point, the company decided to enlarge its operations immediately. They erected a plant at Bound Brook, N. J., which by January, 1916, was producing several acid colors, principally acid Scarlet, Fast Red B, and Bordeau B. In a short time they added Lake Scarlets and Orange II to their list. Since that time they have developed their range of products to a remarkable degree and are supplying a wide variety of dyestuffs. One of their more recent colors is an alizarine navy blue for use on raw wool stock or piece goods.

The plant which they erected at Bound Brook includes eighty-seven acres of land, situated just west of the town and between the tracks of the Lehigh Val-

Plant of Atlantic Dyestuff Company, at Portsmouth, N. H.

ley Railroad and the Philadelphia & Reading Railroad. They have exceptional transportation facilities as both incoming and outgoing freight is handled on private sidings from the Lehigh Valley, Philadelphia & Reading, Central Railroad of New Jersey and Baltimore & Ohio Railroads. The manufacturing buildings are modern in construction and operations are facilitated by the presence of underground pipe tunnels for the transportation of steam, compressed air, electricity, etc. Automatic sprinklers protect the plant against fire.

The executive offices of the company are located in a brick and steel office building at the plant.

One of the steps in the development of the company was the purchase of the chemical interests of the United Process Company whereby the Calco Company took over all of their plants and equipment for making methylene blue, dimethylaniline and other intermediates.

The company has become one of the prominent factors in the American dyestuff industry through its efficient research, manufacturing and selling departments.

John Campbell & Co.

JOHN CAMPBELL & CO., were established in the City of New York in 1876 as importers of dyestuffs. In the year 1915 they started the manufacture of phenol in Newark, N. J. This coal tar derivative was subsequently followed by a series of azo dyestuffs, the first of which to be produced was the well known napthol green. In 1916 the plant was extended until it now covers about ten acres.

In 1918 they purchased and developed the Republic Color & Chemical Works, Reading, Pa., where they are producing H Acid and other intermediates.

The Newark factory is now producing one hundred and ten separate and distinct products, embracing a comprehensive range of direct cotton colors, acid colors, chrome colors, and alizarine colors. Rapid strides have been made in research connected with the more uncommon dyestuffs and at the present time the company is erecting a new group of buildings which will be devoted to the manufacture of some high-class specialties which heretofore have been lacking in the groups of dyestuffs manufactured in America.

The parent office of the company is located at 75 Hudson Street, New York, with branches in Boston; Philadelphia; Providence; Chicago; Toronto, Ontario, Canada; Manchester, England; Shanghai, China. Warehouse stocks are carried at all of these centers.

Central Dyestuffs & Chemical Company

THE Central Dyestuffs & Chemical Company was incorporated in 1898. Dr. G. A. Prochazka is president, H. A. Metz, vice president and treasurer, and G. A. Prochazka, Jr., secretary.

The plant is located on Plum Point Lane, Newark, N. J. This company is engaged in the manufacture of intermediates and azo dyestuffs for cotton and silk. It also manufactures dyes for color makers, and a comprehensive line of oil colors for general purposes.

When the war prevented the importation of foreign dyestuffs, manufacturing facilities were extended largely and rapid expansion has taken place since.

H. A. Metz & Co., Inc., are selling agents with main office at 122 Hudson Street, New York, and branch offices in Boston, Philadelphia, Providence, Chicago, Charlotte, and San Francisco.

The Chemical Company of America, Inc.

THE Chemical Company of America, Inc., a New Jersey corporation, was formed in March, 1915, for the sole purpose of exploiting coal-tar chemicals. It started originally with the idea of manufacturing intermediates for the trade, nitro benzol being the first product offered. Subsequently, the following products were developed and marketed: aniline oil, aniline salt, benzidine, dimethylaniline, diphenylamine, and metaphenylenediamine.

The company would have started the manufacture of toluol products earlier but all toluol products were so prohibitive that it was obliged to wait until prices came down, and in the early part of 1917 it developed the following toluol products: orthonitrotoluol, dinitrotoluol, metatoluylenediamine, orthotoluidine, paratoluidine, and paranitrotoluol; and later on, developed the following: paranitracetanilid, paramidophenol, paraphenylenediamine, nitro xylol, xylidine, benzyl chloride, and benzaldehyde.

During the early part of 1918, it commenced to manufacture monœthylaniline, ethylbenzylaniline, diethylaniline, ethylbenzylaniline sulphonic acid, metaoxybenzaldehyde, michler's hydrol, michler's ketone, amidoazobenzol, and amidoazotoluol.

It also manufactured for the United States Government cellulose acetate, benzyl benzoate, and benzyl acetate, used largely in the coating of aeroplane wings.

Today, this company is manufacturing at its plant at Springfield, N. J.: acid green, formerly known as Berlin's guinea green; acid violet, formerly known as Cassella's formyl violet; wool green S, similar to Sandoz wool green S; acid violet 10 B, formerly know as Bayer's acid violet 10 B; azo phloxine; azo fuchsine; azo violet; wool blue G; xylene blue; and other colors of the triphenylmethane series, as well as the following direct colors: direct orange, direct violet, direct green, direct yellow, and others.

The Cincinnati Chemical Works, Inc.

THE Cincinnati Chemical Works, Inc., is a Delaware corporation, organized on July 1st, 1920, and representing the Swiss dyestuff interests, which took over the dye and chemical properties of Ault & Wiborg Co., Cincinnati, Ohio. The three Swiss firms included in the syndicate which purchased these properties are the Society of Chemical Industry of Basle, the Sandoz Chemical Works and J. R. Geigy. All of these firms have plants at Basle, Switzerland, and in addition the Society of Chemical Industry of Basle has plants in several other places in Switzerland and in France and Russia and England.

When the negotiations were completed it was announced by L. A. Ault, president of Ault & Wiborg Co., that the dye and chemical plants of his company would be enlarged and the operations extended. It was stipulated that not one cent of German money, directly or indirectly, remotely or otherwise, would or could be used at any time in the acquisition or the expansion of the industry. The negotiations which led to the sale were begun in February, 1920, when engineers representing Swiss interests made a complete inspection of the plants at Cincinnati. The parts of the Ault & Wiborg Company other than the dye and chemical properties will continue to be operated by that company under the same management and policies as formerly.

The Ault & Wiborg Co. has been an important factor in the development of dyestuff industry in the United States, having entered the ranks of dye manufacturers shortly after the outbreak of the European war. It is probable that within the course of the next few months more definite information will be available regarding the plans along which the Cincinnati Chemical Works Inc. will operate the dye and chemical properties which they have purchased.

Consolidated Color & Chemical Co.

THE Consolidated Color & Chemical Company was incorporated in 1902. H. A. Metz is president, Dr. G. P. Metz, vice president, Charles Fuehrlein, treasurer, and J. R. Ruether, secretary.

The plant is located at Brown Street and Lister Avenue, Newark, N. J., and is engaged in the manufacture of an extensive line of cotton sizes, finishes, soluble oils, turkey red oil, and leather oils. In dyestuffs it produces a complete line of sulphur and basic dyes for cotton, and mordant dyestuffs for wool.

Plant facilities were extended largely soon after the outbreak of the European War when importation of foreign dyes ceased. The capacity of the plant was materially increased to meet the heavy demands of the Government at that time for colors with which army and navy uniform material was dyed.

H. A. Metz & Co., Inc., 122 Hudson Street, New York, are sole selling agents for this company. Branch offices are located at Boston, Philadelphia, Providence, Chicago, Charlotte, and San Francisco.

Croton Color & Chemical Co.

THIS company was incorporated under the laws of the State of New York in 1918 and commenced manufacturing during that year. It is so named as the factory is located at Croton, N. Y., where the company owns a property sufficiently large for manufacturing a considerable quantity of the dyes. It has been, however, necessary to expand as the demand has been greater than the supply, and therefore the company has purchased additional property and is putting in additional equipment in a new building adjacent to the original one.

The company manufactures a considerable number of direct dyeing cotton colors, and has increased its line from time to time; new laboratories are being built and research work is being done to ascertain the best products to manufacture from the standpoint of the demand and commercial possibility. They therefore, expect in the near future, to manufacture an increasing line of dyes not only for cotton, but also a number of acid dyes. The Pioneer Dyestuff & Chemical Co., Inc., are the sole selling agents for the New England territory.

Dicks David Company

STARTING a little over four years ago with a weekly production of 400 pounds of dyestuffs, the Dicks David Company is now manufacturing between one and one-half and two million dollars worth of basic and acid colors annually.

Growth of Company

This company was organized in May, 1916. Its first plant was located in Waverly, N. J., where they manufactured methyl violet only. A year later they removed this equipment to Rosebank, S. I., where they manufactured and utilized the property there as a shipping point as well.

In the meanwhile, they organized the Dicks David & Heller Company, and acquired the property of B. Heller & Company, Chicago Heights, Ills., in the fall of 1917, when they began to manufacture their Fuchsine Diamond Crystals, soluble blues, and alkali blues. The Chicago Heights plant has become the center of their manufacturing operations. All of their manufacture, including that in which they were engaged at Rosebank, is now located there. They have constantly added to their line of colors, and have extended the plant since they took charge of the property.

Products

During the first week of September, the Dicks David Company of New York, purchased the interest of the Hellers, and have taken over the Chicago Heights property, and have placed in their business additional capital for operating purposes. This consolidation makes the company one of the largest American producers of basic colors. They also produce soluble blues, alkali blues, and metanil yellow.

An illustration of the obstacles which must be overcome in building up this new dyestuff industry in America and the problems which must be solved, is best shown by the fact that while the company has been producing malachite green for over two years, they have only recently offered to the trade the large bright crystals which are demanded by the most careful buyers.

Dicks David Company's New Home

The Dicks David Company is proud of their small beginning, consisting of a little plant at Waverly, N. J., with a desk in a New York office building.

Today they own the corner of Varick and North Moore Streets, a plot 80 x 75, where they have located their offices, laboratories, and shipping department.

Their new hame is still in the process of enlargement and improvement, and when present plans are completed, it will constitute an ideal modern building for the research and business departments of the organization.

A Unique Arrangement

In planning their growth, the company realized the necessity of bringing to bear the best chemical knowledge obtainable, in order to increase their yields, utilize their by-products, and by lowering their cost be ready to meet the competition as it may develop.

Knowing the history of the science of chemistry, the company regarded France as the home of the greatest originators of chemical ideas and procedure in the world. With this in mind, the president of the company, during his recent trip to France, entered into an arrangement with Prof. Behal, who holds the Chair of Pharmaceutical Chemistry, Prof. Auge, of the Chair of Organic Chemistry, and Prof. Marquis, of the Chair of Applied Chemistry, of Sorbonne University, France, whereby the Dicks David Company came into possession of their discoveries and applied processes, which they had developed, and the right to those which may develop in the future.

To Solve Special Problems

This arrangement enables them to bring to America, the young men of France especially trained under these scientists in solving special problems with which the company may be confronted.

The Dicks David Company, in turn, will from time to time, send young American chemists to France to study under the direction of these gentlemen the production of products which are needed in the American dyestuff consuming industries.

From time to time, these scientists will visit America to keep in closer touch with the applied methods of the commercial products of the company.

Reasons for Success

There are two important factors which have contributed to the success of the Dicks David Company. One is the fact that they have concentrated on certain specialized colors, and have conducted long and arduous research work toward the perfection of these products.

The other is that, in the words of the president of this company, they regard the men in their organization as their greatest asset, and they have tried constantly to draw into the company men of broad vision and determination to contribute their part in building up the dyestuff and chemical industry which in itself, is a measure of national defence. They have constantly endeavored to endow everyone connected with the company, with the feeling of individual responsibility.

Officers of the Company

R. P. Dicks, president,—for fourteen years with the Hunter Manufacturing & Commission Company, manufacturers and commission merchants.

Albert David, vice-president and treasurer,—formerly with the firm of Ricketts & Banks, consulting chemists.

Major Benjamin F. Welton, secretary.

N. C. Sheild, assistant treasurer.

The Dow Chemical Company

INDIGO has been the foremost color for 5000 years and can be identified chemically on the burial cloths of the Egyptian mummies, dating 3000 years B. C. It was not until 1866 that the researches of Von Bayer gave us an idea of the chemical structure of the indigo molecule. With this knowledge, there soon developed the commercial synthetic production of this most, useful dye which is used extensively in all the common blues in the clothing of the world.

The Dow Chemical Company realized that it would be a distinct advantage for America to have an independent source of supply of synthetic indigo and, after the war had shut off the German product, immediately commenced work on the problems of the production of this important material.

First Indigo Production

This first successful commercial production of synthetic indigo in America was made by The Dow Chemical Company in its plant at Midland, Mich., in December, 1916, and was accomplished exclusively by American chemists and engineers of The Dow Chemical Company's organization. From earliest production to the present, this dyestuff has been of high quality and has been very satisfactory to the textile trade. The capacity of the plant has been expanded several times.

The illustrations appearing herewith are reproductions of paintings done by A. J. K. Hammond of England who has done much to popularize the dyestuff in dustry in that country by executing paintings of the various plants of the British Dyes, Ltd. Mr. Hammond was commissioned by Mr. Dow to portray the various plants of the Dow Chemical Company. The original paintings will be on exhibition at the company's booth at the Sixth National Exposition of Chemical Industries.

While Indigo has long been known as the "King of Colors," it has been found in recent years that combination with bromine produces dyestuffs possessing qualities superior to the parent dye. As the largest producers of bromine, this company felt best fitted to manufacture the brominated indigoes. Their efforts have been successful, and they have been supplying the textile trade with the following products: Dow Synthetic Indigo, 20% paste; Dow Synthetic Indigo, powder; Midland Vat Blue, R, 50% paste; Midland Vat Blue R, powder; Midland Vat Blue 5B, 50% paste; Midland Vat Cadet Blue, 50% paste.

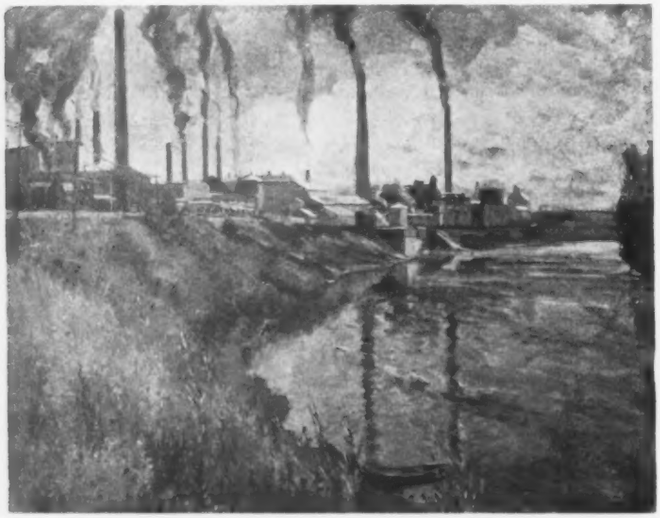
The brom-indigoes listed above under the name of Midland Vat Blues possess all the desirable qualities of indigo and are used in the vat and in print work in the same manner as indigo. They are more easily reduced than indigo and, hence, the vats are more easily handled. The leuco compounds have a greater affinity for the fibre than the leuco compound of indigo, and the penetration of dye is deeper. Once fixed on the fibre, they are harder to remove than indigo, either by destructive or solvent action.

Midland Vat Blue R

Midland Vat Blue R can be prepared for dyeing cotton by the zinc-lime, the bisulfite zinc-soda, or the cold or warm hydro-sulfite vat. Dyeings are a little redder than with indigo, and they are brighter and faster to washing and bleach.

Midland Vat Blue 5B

Midland Vat Blue 5B is considerably brighter and is of a slightly greener shade than indigo. It is much used in



(Reproduced from Painting by A. J. K Hammond.)

A General View of The Dow Chemical Plant from the River

(Reproduced from Painting by A. J. K. Hammond.)

Section of the Indigo Plant of the Dow Chemical Company

Plant of Dicks David Co.

dyeing and printing cotton and produces very satisfactory dyeings, which are faster than indigo to light, washing and bleach.

Midland Vat Cadet Blue dyes the greenest shade of the Midland Vat Blues. It is very easily reduced and is employed for cotton dyeing and printing. It gives very satisfactory blue shades on silk.

Production of Midland Vat Blues is now on a large scale basis, and The Dow Company hopes to make the American textile industry independent of European supply in obtaining these desirable products.

E. I. du Pont de Nemours & Co.

"THE biggest thing in any organization is the men. I would rather see a fire destroy our entire plant than a plague wipe out the men."

This expresses the keystone around which the du Pont organization is being built. All the manufacturers who have striven so hard during the last few years to create a real American dye industry have been enabled to continue in the face of many discouraging factors only by their vision of the need of this industry in our national life. Certainly the du Pont Company in building for the future as it has done in its dye plant has been plentifully imbued with this vision.

A representative of TEXTILE WORLD had the good fortune to be shown through the du Pont dye works at Deepwater Point, N. J. In considering a complicated manufacturing industry such as is the production of colors, it is practically impossible to give a detailed report of a plant from its technical standpoint after a short visit only. It is merely possible to catch the spirit of such an organization.

Phenomenal Growth

The dyeworks of the du Pont Company were started in October, 1917. However, for the first year of their existence attention was concentrated on the production of two colors, namely, indigo and sulphur black. At the end of 1918, both of these products were being turned out commercially. Today the company is producing 104 distinct colors, and the development of this extensive range has been realized within the short space of one and one-half years. In this time, the du Pont Company has reached the point where it is in a position to supply practically all the vital dyes of each particular class, namely, direct cotton colors, basic colors, sulphur colors, acid colors for wool and silk, and chrome colors. In addition they have carried on extensive research work in the manufacture of vat dyes and these are just about ready to be launched commercially. Today there are 4000 men employed in the dye plant while the technical staff comprises 400 chemists. This latter figure is exclusive of those chemists carried on the operating staff. In addition there is a small plant at Lodi, N. J., employing about 200 men, where the company makes a number of basic colors.

The du Pont Company has adopted a series of class prefixes for their dyestuffs: Direct colors are known as Pontamine, chrome colors as Pontachrome, acid colors as Pontacyl, sulphur colors as Sulphogene and vat dyes as Ponsol. They have sucessfully finished lengthy and detailed plant experimental work on eight of the vat dyes. The complete list as it now stands consists of Ponsol Violet R and RR, Ponsol Yellow G, Ponsol Blue G, Ponsol Green B, Ponsol Black B and B Double and Ponsol Blue BO. No doubt as time goes on the du Pont Company will add more of the vat dyes to this list, the while having in view that day when the textile industries of the United States shall be able to satisfy their slightest need from an American dyestuff industry.

The technical laboratory has actual mill equipment where the application of the dyes may be tried out on a large scale. This equipment includes miniature and full size jigs, padders, and printing machines; paper pulp beaters, raw stock and yarn dyeing machines; and machines for dyeing wool and silk in rope form and also drums for coloring leather. There are also winding rooms for making standard skeins of the various fibres. The building contains a conference room where the staff may meet and discuss important problems which arise.

Yarns Winding and Sample Card Room, du Pont Plant

Organization of Plant

The above facts indicate in a general way the progress which has been made in the plant in a very short time. To appreciate the organization which has been built up to make this growth possible and to build for further expansion, one must visit the dyeworks in person and talk to the men who are working on the various problems. A spirit has been developed among the personnel which argues well for the future of the plant. There is a feeling of personal interest in the quality of each pound of du Pont dye turned out which reflects the enthusiasm and sincerity which have been inculcated in the entire organization.

The operation of the plant has been divided into three phases. There is the laboratory end; the "semi-works" department where laboratory methods are tried out on a small scale before commercial production is attempted, and finally the actual manufacture of dyes.

Laboratory Department

The laboratory phase of the plant is again sub-divided into two main divisions; namely, the technical laboratory and the research laboratory. The former comprises roughly the application of the various products to all the different textiles and to paper and leather, while the research laboratory covers the investigation of production methods.

The technical laboratory is a beautifully equipped building which surpasses similar buildings maintained at most of the important universities. Among the many rooms comprised in this laboratory are testing rooms where is determined the strength of the various colors; departments devoted to the application of colors to cotton, silk, wool, paper and leather; separate weighing rooms where this important operation is done by trained experts and the weighed amounts turned over to the laboratories proper; a complete chemical library; extensive filing rooms and offices devoted to the stenographic force.

The research laboratories are known as the Jackson Laboratories. They consist of two large buildings comprising a sulphur dye section, a vat dye section, an azo dye section and other departments covering the various classes of colors. There are also separate weighing rooms and analytical laboratories. For the convenience of the chemists there are maintained a first-aid room and a shower room.

"Semi-Works"

There is many a slip between laboratory production and commercial manufacturing. To eliminate these troubles, the company maintains a vital department known as the Semi-Works. These at present comprise two large brick buildings and several smaller frame structures, and further extension is to be made. Here the laboratory processes are tried out on a scale of 50 pound batches and all the problems which arise are cleared up before the operation is turned over to the actual manufacturing plant. The equipment used in the Semi-Works is practically all constructed at the plant; in fact, the great bulk of the machinery used throughout the works is du Pont-made. To bring this about an extensive machine shop and carpenter shop are maintained with a large personnel.

Actual Manufacture

It is impossible in such limited space to even attempt to describe the various processes of manufacture carried on at the du Pont plant. The futility of even a comprehensive outline can be realized when it is stated that the manufacture includes all the steps from coal-tar distilling, for the production of the crudes, to the pure, highly synthesized intermediates, and the final processes of combining these to form the wide range of du Pont dyestuffs. The indigo plant

(Reproduced from Painting by A. J. K. Hammond.)

Indigo Plant of The Dow Chemical Company

in itself would require pages of description. Then, too, the manufacture of each color is complicated by the existence of a large number of different processes, many of which are patented and distinct with the du Pont plant.

The manufacture of vat dyes promises to be the most important department of the plant, as these colors are so sorely needed by the textile industry.

Technical Laboratory at the du Pont Plant

The details of the production of these important dyestuffs as told to a representative of this publication make an interesting story by themselves. It is almost like a fairy tale to follow the process, beginning with the fine division of anthracene and proceeding down through the intricate maze of sulphonation, fusion and chlorination which finally results in the finished dyestuffs.

Details of Organization

An idea of the scope of the work carried on at Deepwater Point may be gathered from the fact that the dyeworks itself covers an area one mile square. The whole du Pont reservation including the powder works is approximately six miles by two miles, thus providing plenty of room for expansion.

The power house is conducted on an oil burning basis. The conversion from coal to oil was done in the short space of one month at the first of this year when there was a danger of the coal supply giving out. The change now from oil burning to coal burning and vice versa can be accomplished in the short space of twenty-four hours.

A safety campaign is conducted to cut down the number of accidents and the various departments vie with each other in the number of days which they can go without a serious accident. For example one department carried a card reading, "No accident in this department in 170 days." There is also a "Accidentometer" which shows in a graphic way the progress made in safety work at the plant.

To retain a satisfied personnel, an entire village has been constructed where a foreman can secure a house comprising seven rooms and a bath for $15.00 a month and where workmen may secure living accommodations at even cheaper rates. A. Y. M. C. A and other social activities help to keep the men satisfied. The chemical staff is provided with an attractively furnished restaurant where luncheon almost takes the form of a social function.

One more detail of the organization will suffice to illustrate the care with which the personnel of the company is secured and maintained. This pertains to the building up of the technical and sales forces. All those who seek employment with the du Pont dye works fall into one of five classes. They may be fitted for the manufacturing end; they may qualify in the application laboratory or be sent to the branch offices for application work or as mill demonstrators; they may become salesmen; they may become one of the clerical force; or they may be no good at all. The problem of classifying the men requires a great deal of time and observation.

Essex Aniline Works, Inc.

AMONG the more progressive of the smaller dyestuff manufacturers in the country the Essex Aniline Works, Inc., of 88 Broad St., Boston, with plant located at South Middleton, Mass., must unquestionably be placed in the front rank. The first concern in the country to manufacture the useful and necessary dyestuff chrysophenine, for the past eighteen months they have been experimenting extensively on the well-known pre-war German dyestuff known as alizarine green C. G. extra. Tested against the German dyestuffs either as an acid or a chrome color surprisingly good results have been obtained, the Essex product standing up against a light exposure of 40 days even better than the pre-war product. A unit has been installed and this dyestuff is now being produced on a commercial scale.

This company was organized July 10, 1917, by H. W. Hyde of Boston and a Massachusetts charter obtained. S. S. Stevens of the same city was treasurer of the new concern. A large disused paper mill located at South Middletown was obtained and speedily fitted up for the manufacture of the sulphur and direct colors greatly in demand for war purposes. Olive drab sulphur shades and direct yellows and blues were produced in quantity and found a ready market. This concern speedily branched out into the manufacture of other colors and has at the present time about 18 reliable and necessary dyestuffs for the cotton, woolen and silk industries.

The successful manufacture of alizarine green, which is a true alizarine produced from anthraquinone will probably be followed by the production of alizarine blue S. K. Y. The Essex aniline has also had considerable success in the production of pre-war diamine rose and was one of the first companies in the country to synthesize this valuable dyestuff.

In addition to the colors above mentioned this company is manufacturing a complete line of direct yellows, oranges, browns and scarlets, also sulphur colors in green, brown and maroon. Up to recently the Essex Aniline Works sold direct but has now appointed the well known chemical and dyestuff house of Grasselli Chemical Co. as their sole selling agents.

Falcon Dyestuff & Chemical Co.

THE Falcon Dyestuff & Chemical Co., was recently formed, taking over the dyestuff department of Bech Van Siclen & Co., 45 E. 17th st., N. Y. City. They are also sales agents for Andress-Mitchell Chem. Co. of Cincinnati, Ohio, who are manufacturers of Malachite Green and Brilliant Green Crystals.

At present the company is manufacturing in the Texdel Chemical Co. of Providence a line of acid and direct colors: azo yellow; orange 4; brilliant fast red; wool green S; direct pink Y & B.; direct fast rose F. D.; acid green, and other aniline products.

The company will shortly announce the development of anthracene blue.

General Chemical Company

THE General Chemical Co., was formed on March 1, 1899, by the consolidation of the chemical business of twelve distinct concerns. These twelve firms were found after appraisment to have an aggregate capital of $14,008,955. When the company was formed it took over from the constituents the manufacture of only fifteen different chemical products but hardly any one concern was making more than half a dozen and some not so many.

The growth of the General Chemical Co., can be realized from the fact that in 1919 it was making nearly one hundred distinct commercial products besides many hundreds of fine and chemically pure products and the list is increasing. In its early days, the business of the company was confined to heavy chemicals and in fact, today this branch of the industry constitutes the major part of the company's operations.

After years of gradual evolution, the

Dye Testing Laboratory at the du Pont Plant

Essex Aniline Works, Inc., So. Middleton, Mass.

company has developed into a highly organized concern. An efficient staff of research chemists and chemical engineers is maintained. The eastern works are all managed from the New York office. The western plants are operated from their Chicago office, with the exception of the California plants, which are under the jurisdiction of their San Francisco office. The Canadian business is operated by a separate company, the Nichols Chemical Co., Ltd.

Company's Plants

The plants of the consolidating companies have practically all been superseded by new and modern factories. In 1909 the company commenced the erection of a plant near San Francisco, up to that time having had no works west of St. Louis. In 1910 the erection of a new plant was begun at Marcus Hook, Pa., and this has become one of the most important of the company's works. A new plant has been constructed at Pittsburgh to supplant the old plant in that locality. A large works has been constructed since 1903 at Pulaski, Va. Important enlargements have taken place at the plants of the company at Edgewater, N. J., Buffalo, N. Y., Cleveland, O., and Calumet, Ill. A new plant has recently been built at East St. Louis, Ill.

Since 1919 the company has acquired additional going concerns including Baker & Adamson of Easton, Pa., the Thomsen Chemical Co., Baltimore, Md., and the Western Chemical Company of Denver, Colo.

The Company's Products

Of greatest interest to textile manufacturers is the connection of the General Chemical Co., with the dyestuff industry. As is well known, this company is one of the three concerns with which in 1917 a working agreement was made with the National Aniline & Chemical Co. Inc. whereby the latter was assured of its supply of intermediates and chemicals needed in the manufacture of dyestuffs. The other two companies were the Semet-Solvay Co., and The Barrett Co. A merger between the National Aniline & Chemical Co. Inc., and these three concerns has been pending for some time and at the time of writing, plans were said to be near completion. The merger was approved by the directors of the four companies concerned and the new organization is to be known as the Allied Chemical & Dye Corporation. There only remain details of organization to be arranged.

Among the important products manufactured by the General Chemical Co., are sulphuric, nitric, hydrochloric, and acetic acids, Glauber's salt, sulphate of aluminum, alum, epsom salt, sodium sulphide, sodium bisulphite, phosphate of soda, tin crystals, etc. The complete list is far too long to be given here.

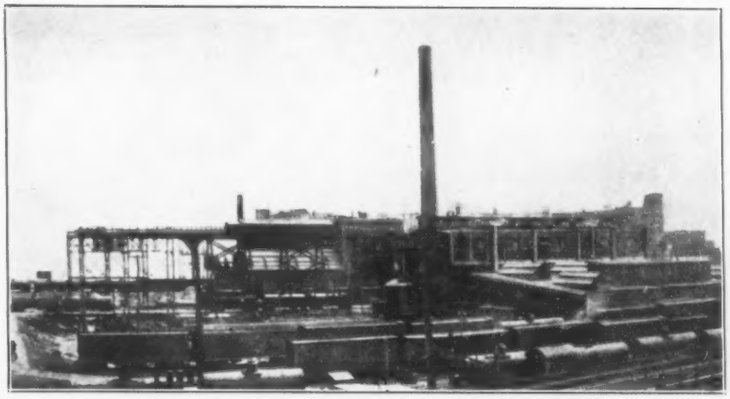
In order to supply its plants with improved earthenware vessels, and steel castings, the company has installed a pottery plant at the Camden works in New Jersey and a foundry plant at the Pulaski works in Virginia. As is natural, it is found necessary in maintaining a great chemical industry to enter upon many other fields. For example, it needs to enter the mining business and the real estate field.

In connection with coal-tar products, the research staff of the company had, before the war, developed processes for a number of these products including hydroquinone, and shortly after the beginning of the war it was able to place on a manufacturing scale the production of diphenylamine, dimethylaniline, diethylaniline, benzidine, toluidine and H. acid. This coal-tar branch of the business was subsequently turned over to the National Aniline & Chemical Co. Inc.

Employe Service Work

Realizing the need of establishing a contented personnel, the company has made provisions for the safety and comfort of its employes. Its manifold plans include safety departments, hospitals, service buildings, physical examination of workers, athletic and social activities, employes' sick and death benefits, and above all, adequate housing plans for the employes at the various plants.

In the twenty-one years of its existence, the General Chemical Co. has by careful organization and efficient research work become a vital factor in the chemical industries of the United States.



Marcus Hook Works of General Chemical Company

Heller & Merz Co.

PARTNERSHIP of this company formed by Frederick Heller and Henry Merz at Newark, New Jersey in 1868. They were at that time the only large manufacturers of Ultramarine blue in the United States.

In 1880 they engaged in the manufacture of aniline colors. The first color developed was methyl violet, but within the year magenta was being manufactured on a large scale.

Later on a tint of azo colors was developed and manufacturing of these colors continued uninterrupted until the outcome of the world war. At that time the plant occupied 26 acres of ground of which 7 acres were under roof. To-day it occupies 52 acres, 20 acres being under roof.

The plant is ideally located on branches of the main line and a complete system of siding, has been installed which facilitates prompt shipment.

At the present time the company is manufacturing on a large scale, the following dyestuffs: azo colors, eosine, bromo fluorescein, nigrosine, fuschine, acid blue, violet, erythrosine and numerous other colors.

Ultramarine blue is of course their most important development.

Hub Dyestuff and Chemical Co.

THE Hub Dyestuff & Chemical Co., Inc., 536 E. 1st St., South Boston, Mass., was formed some 15 years ago by Richard Baybutt, an experienced dyer and colorist. The company was incorporated during the present year. Mr. Baybutt is at the present time on a business trip in Europe and the plant is being managed by his son, R. S. Baybutt. The company has never manufactured any dyestuffs, confining itself entirely to the production of textile chemicals and color pastes exclusively for the cotton printing business. Among the products of the company are the following specialties: Steam black; alizarine yellow paste; acetate of chrome; flouride of chrome, as well as several iron and alumina compounds.

Hydrocarbon Chemical Products Co.

THE Hydrocarbon Chemical Products Co., Inc., was organized and started business in Philadelphia, January, 1917, for the manufacture of fuchsine. The plant in Philadelphia was constantly enlarged until in the spring of 1919, it was found necessary to secure larger space.

The present site in Lancaster, Pa., was then purchased and the plant in Philadelphia was discontinued in August of that year, everything having been moved to Lancaster. This plant has since been greatly enlarged after having been destroyed by fire in November, 1919.

The colors which the company is now producing in quantities are fuchsine crystals OO, fuchsine crystals O, pure soluble blue, soluble blue extra concentrated B, alkali blue, and acid fuchsine.

E. C. Klipstein & Sons Co.

E. C. KLIPSTEIN & Sons' Co., was organized about 1916 with plants at Chrome, N. J., and South Charleston, West Va. The products of this company are sold through A. Klipstein & Co., an organization which was formed by August Klipstein in 1872 in New York, and was subsequently incorporated. The Klipstein interests also control the Bulls Ferry Chemical Co., of Edgewater, N. J. E. C. Klipstein & Sons' Co., and the Bulls Ferry Chemical Co., manufacture various kinds of dyestuffs, softeners, finishers and tanning materials.

A. Klipstein & Co., also represent and are direct selling agents for large producers of certain chemicals and dyestuffs in the United States and Europe. They have branches at Chicago, Philadelphia, Providence, Boston, and Charlotte, N. C. They handle a wide assortment of acid, chrome, direct, developed and sulphur colors, and Ciba and Cibanon fast vat dyes in various shades as well as a line of chemicals, softeners, finishers gums and oils.

Lamie Chemical Company, Inc.

THE Lamie Chemical Co., Inc., was founded in 1917 by R. D. Lamie, president. It is incorporated for $750,000. The company occupies ten acres of land in Huntington, W. Va., and the factory consists of approximately twenty-one plants.

The Lamie Company is a large manufacturer of malachite green, brilliant green, violamine, flaming red, methylene blue and a few other dyestuffs.

Its main office is at Huntington and in addition to its sales office and warehouse in New York, the company has offices in Shanghai, Yokohama and London. Besides Mr. Lamie, who is president, the other officers are John Garvin, vice president, and W. J. Tripp, secretary and treasurer.

The Mathieson Alkali Works (Inc.)

THE Mathieson Alkali Works, Inc., are manufacturers of caustic soda, all grades—soda ash—soda bi-carbonate—bleaching powder—liquid chlorine and tetrachlorethane. All of these articles are used in the textile industry.

At Niagara Falls Works the company manufactures "78% electrolytic" caustic soda. The purity of this caustic is indicated by the fact that domestic supply of "C P" grade caustic stick, comes from this source and this commodity was supplied by the Niagara Falls plant during the war when foreign importations were cut off. It is doubtful whether the imported product will ever again regain its former position. Caustic soda for mercerizing should be pure caustic to get the best results.

This company long ago appreciated the value of scientific research and made a thorough study of lime from all known sources for the purpose of making the highest quality of bleaching powder. Many textile bleachers have installed equipment for the utilization of liquid chlorine, which in many cases has an advantage over the use of bleaching powder. In this connection liquid chlorine is used with milk of lime or soda ash solutions, making up bleach liquor as desired. Liquid chlorine can of course be stored indefinitely without deterioration and is supplied in 100-lb cylinders, one

ton containers and special tank cars, as desired.

Soda ash and 76% caustic soda are made at the Saltville, Va., works. Soda ash and "crystal carbonate" are widely used in laundering and cleansing and also in softening water and the benefits of proper water softening are of course well known to all textile manufacturers.

There are many variations of old standard products, and new applications and processes are continually being developed and the Mathieson Alkali Works has therefore recently inaugurated a technical service department for the purpose of assisting its customers in these matters.

Merrimac Chemical Company

ONE of the best known, well equipped chemical manufacturing plants in the country is that of the Merrimac Chemical Co., with offices at 148 State St., Boston, and works at South Wilmington and Everett, Mass. Founded as far back as 1853, ten years later they were incorporated and have been doing a large and growing business ever since.

The character of the business done by this company is large and quite varied covering not only chemicals for tanneries, paper mills, steel and wire works as well as celluloid, smokeless powder and fertilizers but in addition they are manufacturers of the intermediate known as H. acid, a product very essential to the production of certain coloring matters and dyestuffs.

Their list of textile chemicals is large, covering many of the essential drugs and chemicals required by the dye, bleaching and printing sections of the textile industry.

Among the specialties manufactured by this company are the following: Acetic acid 28 per cent. and 56 per cent. for dyeing woolen and cotton goods, calico printing and other dyehouse uses; muriatic acid suitable for the carbonizing of woolen rags by what is known as the dry process; sulphuric acid 96 per cent. essential to the manufacture of chemicals and dyestuffs and largely used also by wool substitute manufacturers for the process of carbonization.

Among the alumina products are to be found lump and ground alum, both the ammonia and potash varieties; sulphate of alumina used in sizing, water filtrations and certain dyeing operations; alumina hydrate, and also chloride of alumina both in the liquid and dry form. This material is one of the specialties of this company and is used in the carbonizing of noils, wools and woolen rags. The process has been thoroughly systematized by the Merrimac Chemical Co. and in supplying this material they also provide testing apparatus, certain chemical ingredients for keeping the alumina bath clear so that the process of carbonization may not be interferred with by precipitation of the alumina.

The company also manufactures anhydrous ammonia for refrigerating purposes and also the ammonia of commerce in all strengths and so applicable to the many uses to be found for this chemical in the woolen and cotton industries.

In the soda compounds manufactured by this company are found bisulphite of soda either liquid or dry. This material is used for bleaching woolens, reduction of indigo, and cotton dyeing and as the base for the production of hydrosulphite of soda used in the discharges of colors in cotton printing and the bleaching of colors from woolen rags. Glaubers salts, an essential commodity in the wool dyehouse, is also manufactured on a large scale. Sodium nitrite used in the dyeing of cotton, the developing of black and as a reducing agent is another of the Merrimac products as well as the essential sodium sulphide which finds its use not merely in tanneries for the removal of hair from hides but as an essential ingredient in the production of sulphur colors on cotton goods. For the silk industry the Merrimac Company manufactures tin crystals and the well known muriate of tin for dyeing silks or for weighting them.

Monroe Color and Chemical Co.

THE Monroe Drug Company and the Monroe Color and Chemical Company, of Quincy, Ill., are affiliated concerns. The former has been in existence a number of years with a line of druggists' preparations, including among them Putnam Fadeless Dyes, which are sold in the United States, also in Mexico, Central America and South America. The plant was originally located at Unionville, Mo., but owing to inability to secure sufficient labor, was moved to Quincy, Ill. Even this city has its difficulties in this respect, hence, branch plants are located at Canton, Kirkville and Edina, Missouri.

As is well known, the beginning of the World War, in 1914, left United States in a precarious condition regarding coal tar dyes, as well as certain chemicals needed in their manufacture. The Monroe Drug Company faced a situation of calling in its salesmen from all parts of the United States, or greatly reducing their number, owing to their inability to secure sufficient dyes. The only alternative was to build a plant and manufacture—first, the intermediates needed, and afterward the dyes themselves. The color and chemical plant on the banks of the Mississippi is the result.

Before the war, Germany monopolized the world's trade in coal tar dyes. The very few plants in the United States produced only an insignificant fraction of our own actual requirements. They produced only a few of the hundreds of different kinds of these dyes. Such an air of mystery was thrown about the industry that it was generally believed that good coal tar dyes could be made nowhere except Germany. The belief was not confined to the general public, but was shared by some of the actual users of dyes, as the following incident will illustrate. Shortly after the United States entered the war, the company's president, wishing to display a larger Old Glory than he had hitherto owned, visited what was claimed to be the largest flag factory in the world. He asked to be shown nothing but flags whose colors were fast. The attendant assured him that all of their flags were colored with the best dyes in the world, as they, themselves, imported all they used from Germany, and had a good stock on hand when the war broke out. It is, therefore, probably a fact, that the Yankee marched against the Huns carrying flags dyed with colors made by the Huns.

All this has been changed; United States need no longer depend upon a foreign country to make dyes for the Stars and Stripes. There are a number of concerns in this country which can well take care of that. The history of the Monroe Color & Chemical Company, and its experiences, will find a parallel in that of other companies.

Obstacles Encountered

Starting a dye plant after the United States entered the war, was beset with many difficulties. Labor was difficult to get, machinery likewise was almost unobtainable, but these were minor troubles compared with the problem of knowing what to do and what to get. As previously stated, the manufacture of coal tar dyes requires certain coal tar derivatives or intermediates as these are called. Experimental work was necessary to learn how to make them, then engineering work to design the machinery, and finally to build a plant.

The Monroe Company decided upon only one line of colors, namely, direct union colors, and to make these it required H acid, as it is generally called. No concern in this country could supply it, so as early as 1915, N. E. Monroe began a study of the manufacture of this product. After months of hard work experimenting he was ready to build. He began in 1916, and after many more months of experimenting and altering he was finally able to produce H acid on a commercial scale, and was one of the first in the United States to achieve this. While H acid was the most difficult intermediate to make, he felt that with the main problem solved, he could go about designing and erecting plants for the products necessary for the manufacture of direct union colors. For a time, therefore, the company sold its H acid to manufacturers who concentrated their energies on making dyes from intermediates purchased from others who were fortunate enough to be in a position to make them.

Production Extended

An account of the difficulties encountered in making benzidine, tolidin, Dinitro benzol, meta-phenylene-diamine and meta-toluene-diamine would require more space than an article of this kind permits. Suffice to say, in time, these were all produced on a commercial scale. In the meantime the research laboratory was busy, and in 1917—benzo blue B.B., benzo purpurine 4 B., and Congo Red, were produced on a commercial scale. In 1918, diamine green was added and in 1919, benzo orange, grass green and direct black, and other colors, became part of their line. Other colors are soon to be put on the market.

The plant has grown steadily since 1919, but at no time has it been able to meet the demand for its products. While it has not sold any H acid in the last two years, it could have sold many times the amount produced. At present they are doubling the capacity on this product and either doubling or trebling the capacity for other intermediates and dyes. The company has been giving, is giving, and will continue to give a good account of itself, and will be a factor in preventing Germany from ever again controlling the dye industry in this country. This company is only one of the many in the United States working to the same end. The history of one is the history of each of the others. Each and every one of them had to spend vast amounts of capital in research, experiment, installing and discarding machinery, rebuilding, etc., before commercial results were obtained. Five years is not a long time to establish a new industry, and it will not seriously be contended by any one engaged in the industry that the United States can, at the present time, produce coal tar dyes as cheaply as Germany. It is stoutly maintained by the producers, and corroborated by the consumers, that United States can and is producing dyes equal in quality to any ever imported. It need never again be said that the dyes on our national emblems were made in a foreign country.

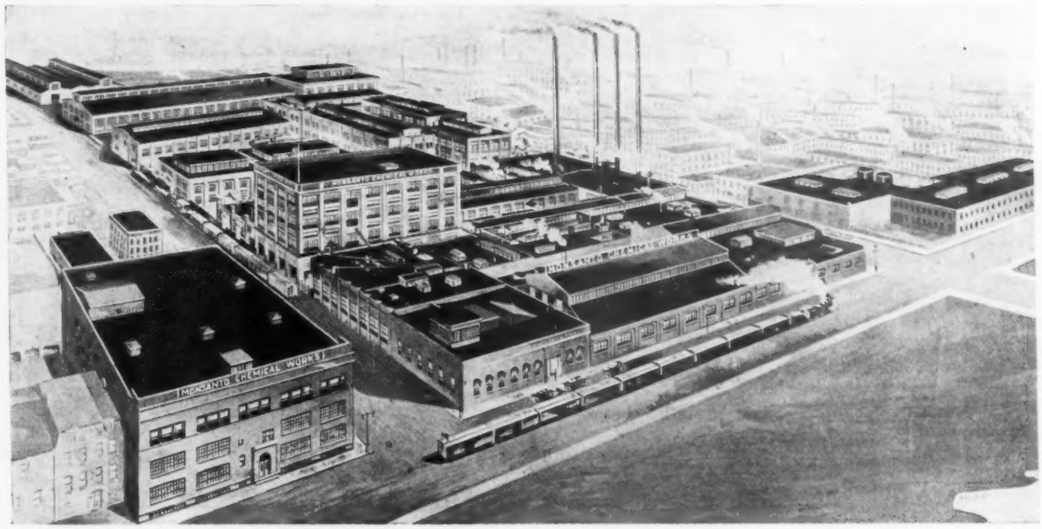
Monroe Color and Chemical Co., Quincy, Ill.

Monsanto Chemical Works

AS the primary business of the Monsanto Chemical Works, St. Louis, Mo., is the manufacturing of fine and medicinal chemicals, they do not manufacture, or contemplate manufacturing, dyes of any description. They produce all the intermediates necessary for the manufacturing of their main products, and necessarily have a surplus of these intermediates which must be made in large quantities in order to effect economical production.

It has been the policy of this company to begin from the ground up and make all their raw materials which they can produce economically, in their two factories; one which is located in St. Louis and the other in E. St. Louis just across the Mississippi River.

At the St. Louis plant, sulphuric acid of all grades, nitric acid, muriatic acid and other heavy chemicals are manufactured. A large part of this output is consumed by the St. Louis plant. The company has also erected a large electrolytic chlorine and caustic soda plant which is



St. Louis Plant of Monsanto Chemical Works

just now coming into operation, and which will supply not only their own wants, but a large part of the Middle-West territory as well.

Intermediates are being supplied to various dye manufacturers in large quantities for conversion into commercial dyes. It is a well known fact that Monsanto is in the front ranks in the manufacture of such important intermediates as phthalic anhydride, anthranilic acid, orthonitrochlorbenzol, paranitrochlorbenzol and others, which they supply not only to the domestic market, but to European manufacturers as well.

The National Aniline & Chemical Co., Inc.

AMONG the many romantic chapters in the industrial history of the United States—tales of apparently insuperable difficulties overcome, and obstacles surmounted, the story of how the chemical and dyestuff situation precipitated by the outbreak of the great war, was met in this country, will occupy a prominent place.

Prior to 1914 there were but seven concerns in the United States engaged in the making of coal-tar products, including dyes, and these were continuing their operations either at an actual loss, or at least without profit, and in the somewhat forlorn hope that there would be some development, either in the form of more considerate legislation, or extended markets, which would justify their courage and persistence.

The coal-tar chemical industry had, since the first basic discovery of William H. Perkin, in 1856, passed into the undisputed control of the great dye-making plants which had come into existence on the banks of the Rhine, and the color needs of the leading textile nations, Great Britain, France and the United States, were supplied almost exclusively from that source.

The few small plants engaged in producing coal-tar dyes in this country existed under the sufferance of the foreign interests, and could hardly be termed American undertakings, in that they were almost entirely dependent on imported supplies for their raw materials, and the very personnel which provided the technical knowledge for their operations was drawn from the same source.

At any moment the activities of these concerns could have been terminated through the cutting off of their supplies of raw materials, and, in fact, great care was observed to prevent the exportation of intermediates which might seriously interfere with the sale of German dyes in this country.

The intermediates allowed for the use of American manufacturers were such as could be converted into dyes, the patents on which had expired, and none were available from which some of the more desirable colors could be obtained.

Under these circumstances there was little inducement for chemists to take up the study of this line of work, and still less for capital to look upon the establishment of a synthetic dye industry as an opportunity for profitable investment.

Some Progress Made

Yet even under these conditions some measure of gratifying success was attained in the manufacture of certain intermediates and dyes, notably aniline oil, direct black for cotton dyeing, and nigrosine, the standard black dye for leather.

Up to 1914 not more than 10 per cent of the coal-tar dyes used by American mills were produced—and that under the most discouraging conditions—by American makers, and the other 90 per cent were complacently accepted by American manufacturers as meeting their requirements, and the origin of this quota excited little or no concern so long as the dyehouses were kept supplied and there was no break in the continuity of deliveries.

Among the makers of coal-tar products contributing to this small percentage of the needs of American manufacturers was the plant of Schoellkopf, Hartford & Maclaglan, afterwards, Schoellkopf, Hartford & Hanna, at Buffalo N. Y.; the Benzol Products Company, at Marcus Hook, Pa.; the Beckers Aniline & Chemical Company, at Brooklyn, and at a later date, the Century Colors Corporation, at Nutley, N. J., and the Standard Aniline Products, Inc., at Wappingers Falls, N. Y.

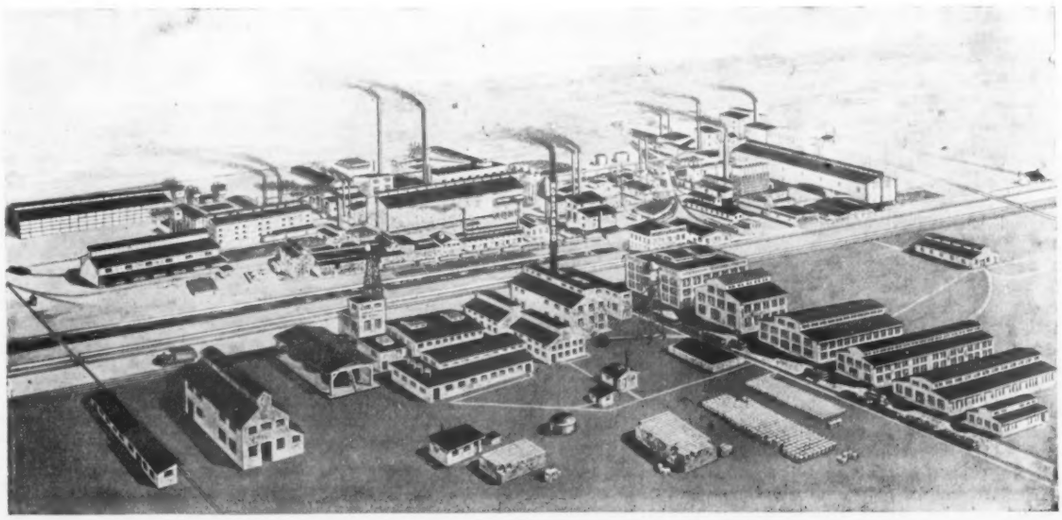
When the blockade established by the Allies on German commerce in 1914 became effective, the burden imposed on the existing plants became stupendous, and the opportunity for profitable development naturally great; how well this burden was carried and the demand met may be judged by the fact that during the first three years of the war, when the supply of German dyes was entirely cut off, no American mill was compelled to close its dyehouses solely for the want of dyes made in America to carry on its operations.

It is to be noted that, in order to establish the manufacture of coal-tar dyes in this country, not one industry only, but three, had to be created. If it had been simply a task of assembling certain standard and easily obtained raw materials, such as would be the case in practically all textile problems, the problem would have been a comparatively simple one; but before the dyes could be made, the necessary intermediates had to be produced, and before the necessary intermediates could be produced the essential crudes, so-called, had to be created.

Difficulties Multiplied

Up to 1917 the task set American dye-makers was to supply the urgent requirements of the manufacturers of commodities for the civilian markets, deprived as they had been of their customary sources of supply; but when America entered the war, the situation immediately took on another aspect, and difficulties which were formidable enough already multiplied a thousand-fold. The needs of the United States Government came first, and the output of the plants making intermediates for the dye-stuff industry was diverted for the manufacture of high explosives and toxic gases for warfare. Collaterally with that, the demands of the textile mills and leather manufacturers for dye-stuffs with which to manufacture Army and Navy cloths and shoes, became more and more insistent, and the dye makers, while finding themselves largely deprived of their indispensable raw materials, were confronted with an unprecedented demand for their finished product.

As if that were not sufficient to tax their energies and capabilities to the limit, Pelion was piled upon Ossa, and they found themselves unable to get deliveries of the necessary mechanical equipment to extend their plants on account of the almost complete appropriation of the engineering and machine building trades by the war demands; and, as a final and staggering



East St. Louis Plant of Monsanto Chemical Works

Marcus Hook Plant of National Aniline & Chemical Co., Inc.

obstacle, they found their technical staffs depleted, and their most expert trained chemists called into the service of the country for the carrying on of the various chemical services which the new developments of modern warfare had made necessary. And, to the credit of American chemists, engineers, capitalists and workmen, it was done.

National Company Merger

In order to more effectively establish a self-supporting dyestuff industry, and to insure an unbroken supply of raw materials, a consolidation of individual plants was announced on May 1st, 1918, under the name of the National Aniline & Chemical Company, Inc. and into this consolidation was taken the Schoellkopf works at Buffalo, the Becker plant in Brooklyn, the Standard Aniline Products plant at Wappingers Falls, the Benzol Products Company at Marcus Hook, and certain others of the General Chemical Company, the Barrett Company and the Semet-Solvay Company at Syracuse.

At the outset of its labors, the National Aniline & Chemical Co. Inc. devoted its efforts to the requirements of the Government, and after those needs were taken care of, to the demands of the color using industries for civilian market purposes.

The principal plant of the National Aniline & Chemical Company, Inc., is located at Buffalo, and it is there that the greatest developments have taken place since the termination of the war.

Laboratories

When the war terminated, and the demands of the civilian population became paramount, all the resources of the company were devoted to increasing the output of dyes for the various kinds of textile and other color using mills, and at the same time, to add to the list of wartime dyes those most useful for other purposes. The facilities of the laboratories were notably increased, new buildings for research erected and equipped in a most liberal manner, and no opportunity passed for securing the most able men to conduct chemical work. The company has a deep appreciation of the value of chemical research and the dye research chemists are afforded great facilities. The Research laboratories are maintained at the Buffalo Works, and it is in them that work is constantly in progress tending towards the development of new dyes.

Besides the elaborate series of research laboratories, there are maintained other laboratories of a somewhat different character. These other laboratories are for the purpose of developing and reducing to practice the results obtained by the research laboratories. It is in these special laboratories that the practical value of a process or dye is ascertained, often long before the dyer and the ultimate consumer are made acquainted with it.

Other laboratories devoted to special work, such as routine analysis and factory control are part of the general organization.

Closely related to the various laboratories is the technical staff, a corps of technologists which stands midway between the manufacturing department which produces the dyes and the dyehouses or printworks where the dyes are used. It is to the men of the technical staff that those often arising and frequently perplexing problems occurring in the mills are referred for solution. The technical staff works in close relationship to the sales force, and to some extent may be regarded as a part of the latter.

Buffalo Plant of National Aniline & Chemical Co., Inc.

Shade Card Department

Working in close co-operation with the production and technical forces is the Shade Card Department with its staff of dyers and textile printers, and others whose duties are devoted to the preparation of the particular technical matter that brings the National dyes directly to the users. The department is fully organized and includes workmen and workwomen who are skilled in every phase of book-making. At present the series of publications cover shade cards for nearly every branch of the woolen and worsted industries, the cotton industry, including mercerized cottons, union goods, garment dyers, cards, etc.

There are in process of completion a number of shade cards of importance to other industries, publications of which will be announced at an early date.

Sales Department

The Sales Department of the National Company keeps in close touch with the consumers, in all textile centers, and it is this contact which is the means of supplying the manufacturing and production departments with that necessary information regarding the needs of the mill. The Sales Directors covering various districts, are in frequent attendance at the executive offices of the company for conferences which are held for the purpose of discussing the several phases of the selling end of th business.

Aid is extended through the Technical Department of the company to the end that the user of their products shall obtain the maximum in results from the dye purchased. It does not matter whether the problem involved, or difficulty encountered, has to do with matters far removed from the actual dye itself.

Marcus Hook Plant

Second only to the Buffalo plant is the Marcus Hook plant which is located on the Delaware River between Chester, Pa. and Wilmington, Delaware.

It is here that a large number of important intermediates are produced from coal-tar crudes, such as benzol, toluol, xylol, and naphthalene.

The present plant is the outgrowth of what was formerly the plant of the Benzol Products Company, the first manufacturer of aniline oil, on a large scale, in this country.

Synthetic indigo is also one of the important products made at this plant, being produced in large quantities.

The Brooklyn plant is located near Jamaica Bay, Brooklyn, N. Y. It is essentially a color making plant. The various groups of buildings cover an area of many acres.

There are manufactured at this plant a variety of important and interesting dyes, including alizarine, made from American anthracene, a product of great value to the domestic textile industry. Some of the fast blues for cotton and wool are also manufactured here, besides a number of other dyes of importance. A variety of special intermediates are likewise produced at this plant. Besides the manufacturing units, there are maintained several excellent laboratories devoted to research and dye control.

The foregoing outline will convey some idea of the activities of the National Aniline & Chemical Company, Inc. and the extent of the work it has undertaken.

The Newport Chemical Works, Inc.

ONE of the pioneer firms to assist in breaking the dye famine caused by the World War was the Newport Company. This concern began to produce intermediates in 1916 at Carrollville, Wis. Among the early products on which they concentrated were nitronaphthalene and refined alpha-naphthylamine. They steadily progressed, adding one, two or three new intermediates each month, and successfully produced such important ones as tolidene, benzidene, H acid, etc.

It was a very logical thing for this concern to expand into the field of dye manufacture. Towards the end of 1917 the Newport Company began seriously to produce dyes at Carrollville, and in 1918 the Newport Chemical Works, Inc., which sells the entire production of the Newport Company, acquired all the assets of the American Color Manufacturing Co., whose offices and plant were located at Passaic, N. J. The main office of the Chemical Works and the distributing center for all Newport products was thus established at Passaic, where they still remain.

Ever since 1918 the company has consistently developed dye manufacture in the various classes, namely, direct, acid, chrome and sulphur colors, culminating in the important announcement last month of the commercial production on a large scale of three vat dyes of the indanthrene series, i.e., Newport Anthrene Dark Blue BO Paste, Newport Anthrene Green B Paste and Newport Anthrene Black Paste.

"Coal to Dyestuff"

The Newport Company is unique among American dyestuff manufacturing concerns in that it owns and controls every step in the production of aniline colors from the time the coal is mined until the finished product is delivered to the consumer. The company has taken justifiable pride in this fact and has embodied it in the slogan, "Coal to Dyestuff," which is prominently identified with all the firm's advertising matter.

The intermediate and dyestuff plant at Carrollville, Wis., is located on a site of over 300 acres on the shores of Lake Michigan, more than half of which is actually utilized at the present time for manufacturing purposes, and where ample space for future expansion is provided. The buildings are of brick

Brooklyn Plant of National Aniline & Chemical Co., Inc.

and steel construction, so arranged as to centralize around the executive offices and new research laboratory and being laid out with due regard for the most efficient handling of the various products through the initial, intermediate and final stages.

New Research Laboratory

The new research laboratory mentioned above is a very handsome one-story brick structure over 200 feet in length and equipped with excellent natural and artificial lighting facilities.

Shortly before the occupancy of the new laboratory, a division of the chemical research department into natural groups was made. There are eight of these groups, each headed by a chief chemist. Each of these groups is as large as the entire original chemical staff of the company. The accommodation of these groups is accomplished in the new laboratory by a division of the space into four distinct sections. Near the center of the building is located the office of the chemical director and a fireproof vault for the permanent chemical records. Ventilation is obtained by means of special equipment which draws the outside air through a water scrubber and sends it to all parts of the building. The floors and walls of the building are of tile.

Among the special conveniences of the laboratory is a plentiful supply of distilled water from a continuous still and large ventilating hoods. Each work desk is equipped with several attachments for steam, compressed air and vacuum, hot and cold water and electricity. Mechanical agitation for experiments is obtained from a line shaft on each deck driven by a motor.

In each of the four divisional laboratories are a dressing room, washstands and lockers for the chemists and their assistant. Adjoining the laboratories and dressing-room are the divisional offices for each chief chemist and his assistants.

During the development of the laboratory there has been an equal increase in library facilities. At present the library contains about 1200 volumes, consisting of the latest patent, descriptive and theoretical literature, together with complete sets of several chemical journals.

New Application Laboratories

An all-important extension of the application laboratories of the Chemical Works at Passaic is now in progress. When the present plans are completed there will be three separate departments. One will be the service laboratory for trade matching, etc.; the second will be the development laboratory, which will be concerned in the production of sample cards and in semi-practical work, and the third will be for standardization work entirely.

A small bleachery which adjoined the Newport property at Passaic has recently been acquired and the buildings, which are of brick construction, with large skylights, will be converted into a modern dye house. Here will be installed, on a small scale, all the most modern machinery for the various sorts of textile dyeing, as well as the coloring of paper, leather, etc. It will thus be possible to test out all of the company's products on a full commercial scale and to offer its clients invaluable advice as to the most satisfactory method of handling each dyeing operation.

In addition to the laboratories and dyehouse mentioned above, additional acreage has been recently acquired adjoining the Passaic plant, on which one large building 20 x 50 feet has already been erected and work on another, much larger, begun. These buildings will house an ample mixing plant and will afford space for the warehousing of a very extensive stock of finished dyes so that consumers may be quickly supplied.

At the present time the Newport Company is making 105 distinct colors, including the three indanthrenes previously mentioned. This number does not include mixtures of any kind, which would swell the figure considerably. Furthermore there are many colors which are made on a semi-scale, but which are not put on the market commercially. The company makes very few basic dyes, but manufactures a line of direct colors second to none in this country. It is the only firm in America making the old Zambesi Black V, which is an important color in the dyeing of hosiery, and is also producing an excellent Rhodamine B in large quantities. The Newport Company is also one of the concerns which first began the production of gamma acid colors, such as black BH, brown M, fast red F, neutral gray G, etc.

In addition to dyestuffs the Newport Company produces many intermediates which are utilized by other dyestuff manufacturers and several other chemicals such as silicate of soda and zinc oxide. It also produces certain coal-tar pharmaceuticals, such as guaiacol, and will shortly be producing photographic chemicals as well.

Peerless Color Company

THE Peerless Color Company, Bound Brook, N. J., began operations in 1916, and was organized and managed by Dr. R. W. Cornelison, who had previously started and managed for a time one of the present larger companies. Dr. Cornelison resigned from his earlier connection in September, 1916, and with others organized and equipped the Peerless Color Company for the manufacture principally of direct cotton dyes, and in the early days mostly of the primuline series.

The Peerless Color Company was among the first in the United States to manufacture primuline. The same is true of the various other dyes made relating to primuline, such as yellow FF and SB—the well-known chloramine and diamine yellows—scarlet A and scarlet 3S. Even in the early days the Peerless Color Company produced a line of yellows, oranges and reds equaling and in many cases superior to the imported German products. Among the early products also were acid yellows, oranges and reds. Dr. Cornelison having successfully manufactured large quantities of acid dyes previous to his organization of the Peerless Color Company.

Arthur L. Benkert, who for 18 or 20 years previously had been connected with the Cassella Color Company, has been secretary of the Peerless Color Company since its organization, and although for a time he acted as vice-president and general manager of a selling company handling the Peerless products, he recently has discontinued the sales agency and remained with the Peerless Color Company in charge of the sales department.

Nils Elkman, for some 18 or 20 years with the General Chemical Company as assistant superintendent and superintendent of various plants of that company, also came to the Peerless Color Company at the beginning as superintendent of the plant.

The Peerless products are well known to the trade. Their aim has always been that when the Peerless Color Company promises delivery, the merchandise shall go forward at the time promised and furthermore the strength and quality shall be exactly as represented. The management makes no secret of the properties of the dyes produced. A dye suitable only for carpet yarn is not urged upon a manufacture of hosiery. The purchaser is told the weak points as well as the strong points of the product.

During the last summer, the outstanding stock of the Peerless Color Company in hands not actively engaged in the company's work, was obtained by purchase by Dr. Cornelison. At the present time he and his associates in the active management of the company own every share.

The company maintains a research department in competent hands and is constantly adding new products, but devotes its attention to products of special merit, rather than dyes of large tonnage which are used in the cheaper line of textile work.

Radiant Dye and Color Works

THE Radiant Dye and Color Works, Brooklyn, N. Y., manufacturers of fuchsine, have been established less than two years, yet already are one of the successful of the dye manufacturers. While not of great size when compared to several similar enterprises, this company is, nevertheless, a recognized factor in the trade because its entire effort up to the present time has been concentrated upon the production, by the approved formula, of a single dye—namely, fuchsine—or more properly, para fuchsine.

For many years fuchsine has been in great demand by paper mills, silk and cotton dyers, leather manufacturers and ink and color makers.

The object of the Radiant Dye & Color Works has been to supply this demand with as good a product as was formerly imported.

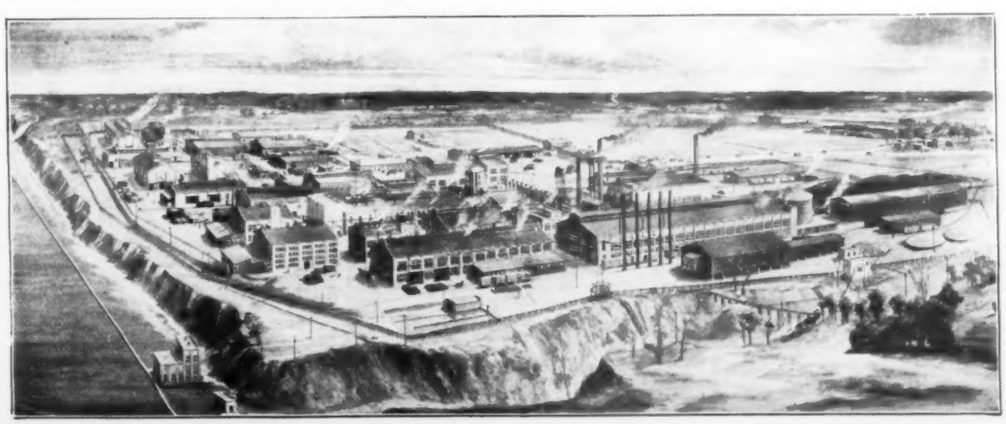
The success attained is perhaps best indicated by the fact that in a little over a year this factory has produced 80,000 pounds of fuchsine.

The bulk of this production was used in America, because in their effort to satisfy the American user of dyes, the Radiant Dye & Color Works made most of their product in powder form, which form is not desired abroad, crystals being preferred by the foreign market.

Success in making the proper quality of fuchsine in a large way now justifies the makers in increasing their production and making greater advance by converting a part of their fuchsine into alkali and soluble blues. These blues are in great demand—and this demand is now but poorly satisfied. Within a short time these valuable blues will be offered. Rosaniline base, the next step after fuchsine in making rosaniline blues, is now being produced in quantity, and the work of conversion will continue as rapidly as possible.

While preparing to supply alkali blue, the Radiant Dye & Color Works will not neglect their fuchsine customers, and have recently added to their line a new standard called "Fuchsine Y Fine Crystals."

John Michel, owner of the Coney Island Independent Ice Plant, and president of the Coney Island Independent



Plant of Newport Company at Carrollville, Wis.

Fuel Co., is sole proprietor of the Radiant Dye & Color Works. These plants are all located on Mr. Michel's extensive property at the mouth of Coney Island Creek, and are operated conjunctively. John W. Van Aalst is Mr. Michel's partner in the dye works and is general manager thereof. Wyckoff Bennett has charge of the sales and credit departments. Albert B. Cook is auditor and superintendent of the several plants.

Raritan Aniline Works

THE Raritan Aniline Works were organized in November, 1919. The company took over the plant of the Middlesex Aniline Company at Lincoln, N. J. Their products are limited at present to the following: aniline oil, oil of mirbane and nitro-benzene. Their avowed intention at the time of incorporation was to produce as good aniline as possible at as low a price as possible and they have built up a reputation on the quality of their product.

They actually started to produce aniline about the first of this year. They have now purchased a plot of ground on the Raritan River just below New Brunswick, N. J., and have a plant in process of construction for the manufacture of sulphuric acid, nitric acid, muriatic acid, aniline oil, aniline salts, oil of mirbane and nitro-benzene. They also expect to make acetanilide with a possibility of later going into the manufacture of dimethylaniline.

The company was originally capitalized at $250,000 but has recently increased its capitalization to $2,000,000. The officers are as follows: William P. Kirby, president; T. G. Bush, Jr., vice-president; Clarence E. Case, secretary, and A. B. Hamby, treasurer and general manager.

The new plant which comprises about 38 acres will probably be in operation by the first of next year.

Semet-Solvay Company

THE Semet-Solvay Company was organized in 1895 to develop in America the coking of coal with the recovery of its by-products. This industry was brought to this country by The Solvay Process Company, primarily, for the purpose of producing a reliable supply of ammonia for the manufacture of soda by the Solvay process.

The first plant of by-product ovens in America was started in Syracuse in 1892, with a capacity for coking 110 tons of coal per day. From this small beginning has grown the great by-product coking industry in America which now has a capacity for carbonizing over 47,000,000 tons of coal per annum with new construction under way which will add some 15,000,000 tons to this amount.

In October of last year the production of by-product coke exceeded the output of the bee-hive oven, and by-product coke may now be regarded as the standard coke of the country.

There is still a great field for further growth of the industry as the bee hive plants become obsolete, as it is probable that no new bee-hive coking plants will be built except in exceptional cases.

It is fortunate indeed that the by-product coking industry was so fully developed at the time this country entered the world war. Practically every high explosive used in the war, and most of the colors and dyes we are making to replace those formerly made in Germany, and many of the drugs that were essential in our war hospitals, are produced from raw materials obtained from the distillation of coal. It is hard to realize what our position would have been as participants in the war if we had not had available the products of the by-product oven.

The Semet-Solvay Company has grown in the twenty-four years of its history until it now has twenty-five plants operating or under construction, most of which it controls or is directly associated with. These plants are all situated in the territory east of the Mississippi River.

Controls Raw Materials

As the company has grown, it has developed the policy of controlling its raw materials and carrying its manufacturing processes through to the finished products by direct ownership, either wholly or in part.

It produces a large portion of the coal used in its plants at its own mines, twenty-four in number, located in West Virginia, Kentucky, Pennsylvania and Illinois.

In addition to owning the mines from which most of its coal is obtained, it operates blast furnaces which use its coke for making pig iron. It is also associated, by part ownership, in some of the larger steel industries of the country.

Coincident with the growth of this company have grown the chemical industries of America. From the first, the company carried on the manufacture of many chemicals based on the distillation of coal. For many years it was the only producer on an important scale in America of benzol, toluol and solvent naphtha which came into prominent notice during the war, as they are the raw materials from which are made many of the modern high explosives.

Eighteen years ago, the company began the production from its benzol of synthetic carbolic acid in large quantities, mainly for the conversion into picric acid and ammonium picrate, which it produced for the Government. Since then the company's chemical products from the distillation of coal have grown to more than twenty articles.

Interest in Dye Firm

In accordance with its policy of associating itself with the industries related to it, the company has a part ownership in The Barrett Company of New York, producer of tar products and sales agent for ammonia products—benzol, toluol and solvent naphtha. It also holds an important interest in the National Aniline & Chemical Company, Inc.

The Semet-Solvay Company has organized complete research laboratories and a large technical staff, specializing in the various sections of its work. These facilities are largely used in perfecting new products and new processes to meet the rapidly growing requirements of the industry.

The Sherwin-Williams Co.

THE Sherwin-Williams Co., entered the dyestuff industry after the outbreak of the war but since that time has become one of the large manufacturing concerns in the industry.

Consequently, although their development has been concentrated within the past four or five years, they are now very extensive producers of dyes, chemicals, intermediates, dry colors, coal-tar products, etc. They manufacture these products for various trades, such as the paint, printing ink, lithograph, fur, leather and other industries.

Dye, Chemical, Coal Tar and Color Division of the Chicago Plants of The Sherwin-Williams Co.

The complete story of the Sherwin-Williams Company was delayed in the mails. Additional details will be found in the Dyestuffs Department of Section 1 of this issue.

Staier Chemical Company

WITH only a little more than two years of actual manufacturing time to their credit, the Staier Chemical Co., whose plant is in Newark, N. J., has grown from a modest beginning to a place of considerable importance in the manufacture of fuchsine, and is now perfecting plans that will give it added importance in the dyestuff and chemical manufacturing industry.

In June, 1916, the Staier Chemical Co., was formed and a few months later it was incorporated under the laws of New Jersey, with Henry Staier as president and Julius C. Staier as secretary and treasurer. Its early intention was to confine its activities largely to the production of alizarines and paranitranilines. Production went along in a satisfactory manner during the remainder of that year, but in 1917 shortly after the entry of this country into the war, the Staier plant was diverted from commercial work and all its abilities were concentrated in the manufacture of a product used in munitions.

The plant was devoted entirely to Government war work from early in 1917 until the signing of the armistice. In due time, after the ending of the war Government work was stopped and the plant once again turned its manufacturing efforts to production of commercial properties.

Production Turned to Fuchsine

With the return of the plant to commercial production, the Staier interests departed from their original manufacturing intentions and changed their equipment to the manufacture of fuchsine. At first the production was expectedly small, and did not total much over 500 pounds weekly. The plant all through the year 1919 was devoted exclusively to the manufacture of fuchsine and at the end of that year the initial production of 500 pounds weekly had been increased to 2,000 pounds weekly. At the present time another manufacturing unit is being erected at the plant, and when this is put in operation the production will be increased another 500 pounds weekly.

Having perfected the production of fuchsine, and bringing it to a point where its future success seems practically assured, the company devoted its experimental energies to other channels with the result that part of the plant was turned over to the manufacture of Wool Blue G Extra. The production of this color has already proved a success so far as the company's ability to make it is concerned, but production in bulk has been hampered somewhat by a few difficulties outside the direct control of the company. For instance, toward the latter part of 1919 the company was unable to secure the necessary raw materials for the wool color and production had to be suspended. About three or four months ago, however, the company was again able to secure the raw materials and production is now going on at the rate of about 500 pounds a week. The experimental work in this connection has been thoroughly completed and further energies will need only to be devoted to the increasing of production.

Fire Stops Plant

On May 28 of this year, when the plant was being operated in a successful manner operations were entirely stopped by a fire that entirely crippled the plant. So disastrous was this fire that operations were completely stopped for two months, and it was not until the first of August that the plant resumed work. During the time of suspension of operations the management of the company considered various plans for the betterment of operations, with the result that when work was resumed new machinery and equipment was installed. The new unit, increasing the production of fuchsine from 2,000 pounds to 2,500 pounds weekly, was part of the new installation, and other work of this character included processes which materially do away with manual labor in the handling of production. For

instance, in the place of 16 75-liter retorts the fuchsine melt is now handled by four enameled kettles, and while the melt was formerly carried from process to process by hand it is now distributed by pressure and gravity. As a result of these perfections in the equipment of the plant, the company is able to keep up production to the full manufacturing ability of the plant with not more than 20 operatives.

Wool Blue Appears Successful

An executive of the company in discussing its product was unusually enthusiastic over the prospects of success for the new wool blue G extra. He said that the company is planning an extensive increase in the output of this color, for after experimental work had been concluded it was shown that the company could produce the dye in a successful commercial manner. The report of a consulting chemist, who analyzed a sample of the color for fastness is of interest. Part of this report is as follows: "This dyestuff is most properly dyed in a neutral bath containing from 10 to 20 per cent of glauber-salt together with the dyestuff. Start the dyebath at 160 deg. F., gradually raising to the boiling point and dyeing at that temperature for one hour. Dyed in this manner, the levelling properties of this dyestuff are good and the color is a brilliant greenish shade of blue. By dyeing in a bath containing three per cent. acetic acid and 20 per cent glauber salt, a somewhat better exhaustion of the dyebath is obtained but the color does not dye as level and also it seems to be somewhat duller in appearance. Also by dyeing in a bath which is started neutral but which is exhausted by the addition of two per cent sulphuric acid towards the end of the dyeing, the bath may be exhausted completely but the color is somewhat duller in appearance.

"The strength of this sample of Wool Blue G Extra is about equal to the prewar commercial type as far as I can judge from the sample books of dyeings of this color."

Sterling Color Company, Inc.

THE Sterling Color Company, Inc., a New York corporation, was organized by Warren C. King, president of the Independent Chemical Company of New York City and the King Chemical Company of Bound Brook, N. J.

Warren C. King has been identified with the chemical industry since 1896. He organized the Independent Chemical Company in 1907, the King Chemical Company in 1915, and the Sterling Color Company in 1916.

Entering the field of dyestuffs Mr. King found it desirable to separate the color business from the chemical and in 1916 he secured the services of several dyestuff chemists and incorporated the Sterling Color Company.

Recognizing the opportunities in the color industry Mr. King financed a plant at Bound Brook to manufacture fast cotton colors. Mr. King later disposed of his holdings in the color company and immediately secured a plant in Passaic manufacturing not only very much the same line of cotton colors, i. e., those made from para toluidine, including primuline, direct fast yellow, direct fast scarlet and rose but the new plant is also making wool and silk colors such as wool green, azo phloxine, azo crimson, azo fuchsine, chrome blue black conc., chrome fast black, and a new direct fast red and direct fast brown.

When asked about the future of the chemical and dyestuff industry in American, Mr. King said: "Remember the answer of the Americans at Chateau Thierry, 'We have only just begun.' The American flag never retreats. We can make chemicals, intermediates, dyestuffs, colors as good or better than any other country in the world, bar none. Let's go."

The Sterling Color Company has recently concluded arrangements with another plant manufacturing dyestuffs.

Williamsburg Chemical Co., Inc.

IN December, 1915, the Williamsburg Chemical Co., Inc., started at 230 Morgan Avenue, Brooklyn, to manufacture sulphur black. When it is remembered that that date was at the very beginning of the war, the difficulties under which the Williamsburg Company labored at its start will be realized. Conditions were extremely unfavorable and many obstacles had to be overcome. Nevertheless the production of this particular color steadily progressed until at the present time, the company is turning out about fifteen times as great a quantity of sulphur black as it did when it first started to produce.

About the middle of 1916, the Williamsburg Company began to make its own benzaldehyde for use in the manuture of malachite green and about the same time started to turn out that dyestuff. This company was consequently one of the very first to produce malachite.

As an incidental stage in its existence, was the manufacture of potassium permanganate which they supplied to the Red Cross after the entering of the United States into the world war.

The company also at one time attempted the manufacture of auramine but the prices on the intermediates required for this dyestuff made the selling quotation prohibitive and the company gave up its work along this line.

Sulphur Brown for Khakis

Another result of this country's participation in the war, as far as the Williamsburg Company was concerned, was the beginning of the manufacture of sulphur brown, for use as one of the component dyestuffs in the production of khaki shades. This dye was turned out on a large scale and was used throughout the textile establishments in New England for this purpose.

The next step in the companys' development was probably one of the most, if not the most important one. This was the manufacture of methylene blue. The company has laid special stress on the perfection of this color and has paid particular attention to securing uniformity of concentration and purity of shades. They then developed a methylene blue in crystal form which was zinc free. There are on the market, methylene blues in powder form, zinc free, but this company does not know of any other zinc free product in crystal form. Their installation for the manufacture of methylene blue is a very extensive one.

Other Colors Developed

Brilliant green crystals was the next dyestuff added to the Williamsburg Company's line. They have recently started the production of primuline and chloramine yellow and have both of these colors on the market at the present time.

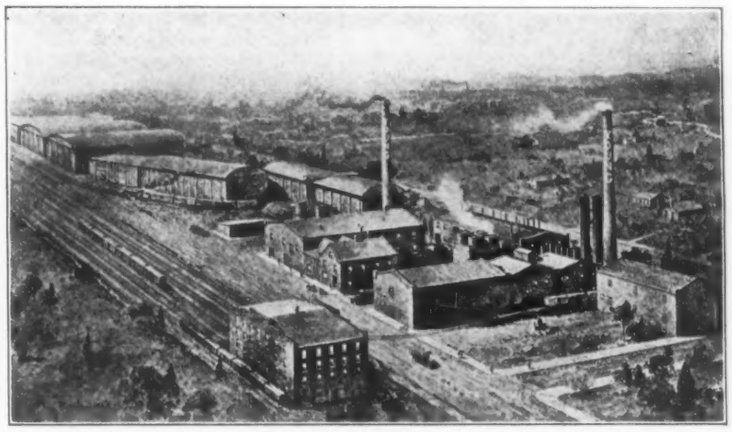
Experimental work is being conducted on several other dyestuffs, which will in time probably be added to the list. Their plant has been greatly enlarged from time to time, and the company has opened executive offices at 61 Broadway, New York, to meet the increasing demand for its products.

J. S. Young & Company

SEVEN natural dyestuffs are manufactured by J. S. Young & Company, Hanover, Pa. These are quercitron bark extract in liquid and solid form; flavine; logwood extract in liquid, solid and crystal form; sumac extract, both domestic and Sicilian; myrobalan extract; divi divi extract and quebracho extract. The last four mentioned materials, as is well known, are used not only in the silk and cotton industries but by the tanning trade as well. This company has four plants located respectively at Hanover, Pa., Shrewsbury, Pa., Baltimore, Md. and Charlottesville, Va.

One of the important activities of J. S. Young & Company is the experimental work conducted by their staff of chemists with a view to producing superior natural dyes as well as simplifying the methods of application. The company states that this research work has been productive of a great deal of advancement along these lines. They call attention to the fact that the manner of application of natural dyes has been a source of considerable concern in the past and was to some extent a handicap in promoting the sale of these materials, especially when placed in the hands of employers inexperienced in dyeing with vegetable dyestuffs. They believe, however, that these difficulties are gradually being overcome and they hope that in the future their application may be made as easy as that of the artificial dyes.

They add that there is no question of doubt but that the popularity of natural dyes will continue to keep pace with that of artificial dyes, now that their real merit has been tested. They point out that this has been brought about by the important part played by natural dyes during the war in supplying the need for dyeing material. They are not in a position at this time to give a great deal of data as to the real progress made in the development of natural dyes. Nevertheless they believe that in the future these products will continue to play a very prominent part in the dye industry of the country, because of the development that will be made through research work in the laboratories of the various natural dyestuff plants.



Plant of J. S. Young & Co. at Hanover, Pa.

Present Position of British Dye Industry*

Need of Protective Legislation Recognized in That Country

IN the House of Commons on July 20, 1920, the President of the [Government] Board of Trade in reply to an inquiry respecting the development of the synthetic-dye industry in the United Kingdom, made the following statement:

The experience of the war made it apparent that the existence of a strong synthetic-dye industry is a military necessity and essential to the defense and security of the United Kingdom, and pledges have on several occasions been given that steps would be taken to protect the industry for a time so as to enable it to be placed on a secure foundation. All the various alternative methods of fostering the industry have been considered, and the opinion of the Government is that assistance can be most effectively given by the prohibition of the importation of synthetic dyestuffs except under license. An undertaking has already been given to this particular industry that this course will be adopted, and accordingly proposals to that effect will be embodied in a bill relating to key industries which will be introduced and proceeded with as soon as possible.

To another member the president stated that the total quantity of synthetic dyestuffs, including a small quantity of intermediates, imported from Germany during the first six months of the current year was approximately 387 tons, of which about 150 tons were received under the reparation clauses of the Treaty of Versailles.

Imports Under License

It appears that the whole question of the dye industry has been receiving very careful consideration since the

* From Consul General Robert P. Skinner, London; Published in Commerce Reports.

handling down of the recent court decision which brought to an end the restriction on imports then prevailing. In an address to the Color Users' Association at Manchester on the 20th instant the President of the Board of Trade declared that the dye making industry in this country is regarded as a military necessity, and pledged the Government to bring in legislation which would make it possible thereafter to import synthetic dyestuffs under license only. This very interesting declaration was made public by the chairman of the reconstruction committee of the association, who furnished also the following details:

> The reconstruction committee has been taking this matter up with the Government. There have been many discussions, and I now have the authority to state that it is the settled opinion of the Government that for national security it is essential that synthetic-color factories should be in existence, should be maintained by a staff of chemists and other experts, and should be equal to those of any other possibly hostile nation. The [illegible] only of opinion that this must be done without undue injury to color users and without placing the textile and other industries in a disadvantageous position.
>
> As color consumers we did all in our power to develop the dye industry of the country, but there are certain ways of establishing it. The Government has said definitely that the subsidy is unworkable, but it has come to the conclusion—and the president has given me permission to say so—that it is going to bring in a licensing and prohibition bill. I cannot give the text of the bill, but we have got to work the bill to the best of our ability, although it will mean that our constitution must be altered. Instead of being a voluntary body, as now, we shall have to form ourselves into a company limited by guarantee and capable of entering into obligations.
>
> Whatever legislation is brought in, it will firmly establish the dye industry of this country; but it is the bounden duty of all dye makers, after they get legislation, to help the association to do its bit. They must get the industry on a firm basis and stand on their own efficiency. Sir Robert Horne has asked me to meet other interested persons next week in order fully to discuss the type of machinery that will be necessary. The Government has already agreed in principle to certain schemes of research and has allocated £500,000, but I cannot say that it is specifically earmarked for the dye industry.

Mr. C. Rawson, chairman of the technical advisory committee, said that, under the reparation clauses of the peace treaty, the Aliles had the option of taking 50 per cent of the stock of German colors existing in 1919, and Great Britian was entitled to 30 per cent of this 50 per cent. In December last the committee was informed that the German stocks amounted to 22,000 tons and comprised 13,000 items. Consequently, if the Allies exercised their option fully Great Britian should receive 3,300 tons. Up to the present the consignments did not account for more than 1,500 tons, and Mr. Rawson stated that it was doubtful if all that amount had actually been received.

In January last the advisory committee visited Germany and purchased 140 tons of dyestuffs at a value approximately of £192,000 [see COMMERCE REPORTS for Jan. 29 and Apr. 8, 1920], and options were also secured on about 700 tons at an approximate value of £1,000,000, but the colors subject to option could only become available when the corresponding amount of reparation colors was released and delivered to the Allies. The option terminated on July 1. The amount of color received from Germany on this account up to the present was about 220 tons, valued at approximately £345,000.

Some months ago, with a view of upholding the principle of collective purchasing of German dyes as the best policy for all concerned, the members of the committee, with the sanction of the firms and combines they represented, agreed among themselves to refrain from buying colors individually, either direct or through agents—a course which was, however, found to be impracticable, as German colors were coming into this country freely, and finally it was decided to rescind the agreement.

Manufacture of Chemical Porcelain

AMONG the subsidiary industries which have had an important bearing upon the growth and development of the dyestuff and chemical field is the manufacture of chemical porcelain. The Herold China and Pottery Company, Golden, Colo., is one of the firms which have been supplying dye manufacturers with porcelain dye pots and beakers. The struggle to establish an American industry of this nature has not been an easy one as may be gathered from the following history of that particular company.

At Golden, Colo., twelve miles east of Denver, there was until December 31, 1914, one of the largest breweries in the State, known as the A. Coors Brewing and Manufacturing Company. The buildings and equipment are still there but prohibition put an end to the operation of this plant. Located in the same town at that time was a small pottery which was financed and fostered by A. Coors, president of the brewing company. This pottery, under the direction of John Herold, first attempted to produce art potteries and later extended its efforts towards the making of porcelain cooking utensils. This concern was known as the Herold China and Pottery Company. Due to one cause or another it eventually failed and the plant was closed. On January 1, 1914, it was suggested that A. Coors, Jr., should reopen the pottery and exert every effort toward making a success of it. In considering this course it was realized that a fertile opportunity was presented due to the accessibility of clay, spar and flint to produce porcelain ware of marketable quality. Moreover it was realized that the closing of the brewery would make necessary some new venture on the part of the brewing company.

Obstacles Encountered

The opening of the pottery immediately followed. For the first six or seven months it seemed to the company that every conceivable obstacle was encountered in their efforts to produce a porcelain ware consistent with their own standards. They had a superior quality of clay in abundance but they soon realized that untiring effort and experience were the factors necessary to accomplish the end they had in view.

During this period they sat tight and persevered. Evidently they had made some impression, for in August, 1914, they received a request asking for price and time of delivery covering 144 small porcelain chemical evaporating dishes. This was their first inquiry for anything in the nature of chemical porcelain and to convert it into an actual order seemed an enormous task. They felt unable to name a price and more particularly to make a promise of date of delivery. They at once referred to the Royal Berlin Chemical Porcelain Catalog. To these price quotations they added 50 per cent ad valorem as this represented the amount of duty paid on porcelain for industrial consumption as opposed to "duty free" or list prices quoted to educational institutions. No other information as to cost seemed available so this plan of price decision was adopted by the company on subsequent quotations as a standard.

It required a period of six months for them to fill this first order for 144 pieces but this initial order gave birth to Coors U. S. A. Chemical and Scientific Porcelains.

Inexperienced Employes

The plant was small and contained only one kiln. They had only a handful of employes who had had scant experience in the making of pottery. As for the management and other executive heads they had but little knowledge of ceramics. With these handicaps was launched an industry which produced commercially for the first time in the United States a commodity which required a specialized knowledge and technique in the various stages of its manufacture.

In the filling of this order hundreds of dishes were made, fired and thrown away. Yet the work gave opportunity for the acquiring of knowledge and experience sufficient to greatly improve the quality of their gradually increasing line of shapes and sizes. In 1917 when the United States declared war, the company was in a position to supply the Government, munition plants, and hosts of industrial laboratories with sufficient quantities of chemical porcelain to meet these increased demands. In the year 1918, 1,347,235 pieces were shipped from the plant.

H. F. Coors, of this company, is confident that every need of the American chemist, as it relates to chemical porcelain, can be supplied by American manufacturers. He points out that in the plant with which he is connected they are now able, after five years of effort and manufacture, to produce 300 different shapes and sizes, every piece of which is, according to the testimony of many well-known chemists with whom he has talked, the equal of Royal Berlin. He believes the domestic manufacture of these products should be fostered and encouraged in order that we may be independent of foreign sources of supply.

Chemistry and the War

(*Continued from page 62*)

It was the flourishing dye industry that was responsible for making their country independent of the world for nitrogenous material. It was very largely their chemists that undertook the laborious research required. They realized in September, 1914, after the defeat on the Marne, that they were in for a long war, and at once large subsidies were paid by their Government for the erection of fresh plant for the production of fixed nitrogenous materials; these are now in existence, in perfect working order waiting their opportunity.

Fixed nitrogen is essential for fertilizers; at the present, at all events, it is equally essential for all explosives. I suggest that the safety of the Empire depends on the establishment of such an industry here, and in its establishment preconceived notions on fiscal policy must be abandoned. If this industry cannot be run by private enterprise it should be undertaken by the State or subsidized by the State.

Chemical Warfare

In the annals of war, the recent terrible conflict will be forever memorable for the appearance of a new arm. Chemical warfare is an advance in the art of war comparable to that of fire arms over bows and arrows; but its possibilities and terrors are much greater, so much so that it is quite likely that the advances made in this arm in the future may deter nations from war.

Chemical warfare commenced by the use of chlorine in the Ypres salient in 1915, and it is difficult to see why its success did not give the Germans the coast. It was followed in 1916 by the more poisonous phosgene, and in 1917 by mustard gas, the use of which spoiled our offensive in that year.

The theory of chemical warfare is in its infancy, but its value has been made manifest. The protective measures, excellent as they were on our side, can be defeated by the use of some different chemical substance. The problems to be solved are numerous and difficult. We know little about the behaviour of gas clouds, sprays of atomized liquids, etc., etc. The time will come when the whole subject will be placed on a definite scientific basis, and woe betide any country that is not fully prepared for the day when the clouds of war again darken the horizon.

No War Office can disregard this new arm; no army can afford to be without its staff of highly trained scientific chemists. One thing is certain—all the materials used, all the new ones yet to be synthesized, will depend on the skill of the chemist. A supply of chemists and of the materials required in chemical warfare will depend essentially on a flourishing dye industry. It is only the foundation of this one particular industry that will create the small army of highly-trained chemists, upon which, certainly, the prosperity of this country will depend, and upon which the safety of the Empire may rest in the wars of the future.

Relation of Dye Industry

In 1914 Germany had the most flourishing dye industry in the world, the most marvellously organized chemical industry the world has ever seen. This dye industry was financially the most successful of all her industries; it is today intact and, for many of its requirements, in a better position than it was in 1914.

Subsidized by the Government, we have commenced to establish such an industry here. It took Germany two generations; we might do it in one generation. It must be fostered by the State for this period, as upon it depends primarily the safety of the Empire.

The nations, appalled by the devastation of this war and feeling blindly that the wars of the future will be still more terrible, naturally think that the red stream which has flowed through the past history of the world has disappeared forever. But if war does appear again in the unknown future, and no one can deny the possibility of such a catastrophe, then the introduction of the new arm has made the possibilities so terrible that it is our duty to those who follow us to be prepared for it.

Success, whether in peace or war, will lie with that country which has the largest supply of highly-trained scientific chemists, essential for the industries of that country in times of peace, essential in war.

German Chemical Industries*

Manufacturing and Market Conditions in That Country

THE Peace Treaty requires that Germany shall deliver to France during each of three successive years, 30,000 tons of sulphate of ammonia, 35,000 tons of benzol, and 50,000 tons of coal tar. The Reparation Commission reserved the right to one-half the supply of dyestuffs and chemico-pharmaceutical product on hand at the time of the siging of the treaty; also an amount up to one-fourth of the product up to January 1, 1915. Now that a year has elapsed since these provisions became effective, it is of interest to read the German reports of company meetings, chambers of commerce summaries, and trade-journal reviews of conditions in the chemical industry.

The two general conclusions that may be drawn from this published material seem at first to be entirely contradictory. The introductory pages of every report and summary discuss the shortage in coal and raw materials, the closing of plants, the scarcity and high cost of labor, and the poor transportation facilities. As a consequence, a very great scarcity of the finished product is reported so that orders can not be filled. Some reports specifically mention the French deliveries as the occasion of the shortage on the market. The impression of industrial hardship that is conveyed in these opening paragraphs is, however, offset at the end of the same reports by the financial statements that record, almost without exception, the declaring of dividends largely in excess of those of 1918. The explanation of the discrepancy is, of course, to be found in the heavy foreign demand at the high prices of the last few months of 1919.

Below are given a few summaries from the German Annals of Economics and Statistics (April, 1920), from the Journal of the Berlin Chamber of Commerce, from trade journals, and from company reports.

Dependent Upon Coal Supply

Resumption of trade in chemicals is dependent upon the supply of coal. Shortage in coal has brought a large part of the industry to a standstill, or, at least, has caused great shortage in production. If now a shortage of raw material is to follow, such deficiency in the supply of sulphuric acid, caustic soda, pyrites, tar, sugar, and casein will itself be traceable to the scarcity of coal. The *Rhenisch-Westfalia Zeitung* for March 1 says some relief was obtained at the end of February by the delivery of American coal which had been ordered but was not until then available.

The chemical industry seems to be at a standstill. The chemico-pharmaceutical industry is in some respects in a better situation than in January, in other respects in a worse position. Dyestuffs have shown a brief revival because of the receipt of a moderate amount of coal.

The shellac industry also makes an encouraging report. Soap reports run from "bad" to "fair." Asphalt and tar products suffered from lack of raw material. Coking plants, producing tar, ammonium sulphate, and benzol, report a freight scarcity; business was in other respects improved over a year ago. Ethereal oils were sluggish, but improving. Benzine and turpentine were not coming on the market. Weak conditions prevailed in the sulphuric acid and fertilizer industries; in the case of the latter, shortage of materials made it impossible to satisfy the demand.

The chemical industry suffered heavily during the past year by reason of the shortage of coal, which became extraordinarily acute toward the end of the year, causing many industries to close. The shortage in other raw materials became more and more serious at the same time that the world demand for chemical products became so insistent. At this juncture many foreign countries put an embargo on the importation of German products. Finally the 25 and 50 per cent deliveries required in the peace treaty affected the chemical market seriously.

Report of Chamber of Commerce

The report of Berlin Chamber of Commerce for 1920 states that the chemical industry and the trade in chemicals, raw materials, and auxiliary products suffered in war time greater changes than most branches of industry. Germany was in normal times heavily dependent upon foreign countries in many matters of production and distribution; this field was entirely cut off by the war. A transformation of the whole industry was the only solution. The brilliant achievements of those who had the matter in hand are testified to in the manufacture of explosives and artificial nitrates. And yet these achievements are merely isolated instances among the many which were accomplished with the raw materials drawn from domestic and a few neutral sources.

Increase in salaries and in wages of operatives as well as ever rising costs of coal and raw material resulted, of course, in continuous increases in costs, which were accentuated by the shortage in coal and transportation. The effect was felt all along the line; the selling price was a mere barometer of conditions. No relief may be expected until the rate of exchange and inflated values have been brought back to normal. The demand is good, indeed almost impossible to meet, and yet production can not possibly be accelerated.

Government Control

Government control of sulphuric acid and other basic products grew more rigid rather than more lax. The shortage of pyrites made it useless to attempt to meet the demand. The maximum prices were set higher and higher, but production was dependent upon more fundamental things than money.

Hydrochloric acid was released from control in March, 1919. After a few months production conditions were such that sales could be made even in Scandinavia and Finland, so that business in this line may be said to have been good. There was also a heavy demand for Glauber's salts, a by-product of hydrochloric; it was impossible to fill the demand in Scandinavia.

Liquid anhydrous ammonia was in great demand. The small production of ammonium carbonate never permitted market prices to be within reason. Raw material for ammonium sulphate was exceedingly scare, and yet the maximum price was so low that manufacture was unprofitable. Nitrogen prices reached a business-profit only toward the end of the war. The production of spirits of ammonia was obstructed at intervals, but it became profitable in time.

Industries Combine

The pigment and dye industries have found it necessary to combine. The German "Bunt-und Mineralfarben Industrie" and the Union of German Dye Industries were formed. These organizations have justified their existence in arranging for allocation of raw materials and the establishing of fixed prices, putting an end to profiteering. Goods for foreign sale were put at a higher price, so as to equalize the low rate of exchange. Prices are now about the same for all consumers. Altogether the dye industries are in a favorable situation, except for the shortage of coal and raw materials.

The lac and varnish industry had a heavier demand than in 1918 but could not meet this demand, as the eight-hour day and scarcity of material prevailed almost throughout the year. In December the restrictions on copal, shellac, rosin, and turpentine oil were removed; linseed oil is still under control.

* Prepared by the European Division, Bureau of Foreign and Domestic Commerce, published in Commerce Reports.

Dye Division of American Chemical Society

(*Continued from page 65*)

Sept., 1918, in Cleveland, O., under the hospitable and fostering wing of the Division of Industrial Chemists and Chemical Engineers. In passing I wish to take this occasion to record the help given us by Dr. H. S. Minor and Dr H. E. Howe, the then officers of this mothering division for new sections of chemical endeavor.

Symposium Well Received

The dye chemists of the country exhibited considerable interest in this Symposium, so much so that Dr. Charles H. Herty published all the papers given at this Symposium in the *Journal of Industrial and Engineering Chemistry*, and later reprinted them in a separate pamphlet which was widely distributed. On the basis of the reception of the Symposium a Dye Section was formed by the appointment by Dr. W. H. Nichols of Dr. C. L. Reese as chairman, and the writer as secretary of the Dye Section of the American Chemical Society.

This section functioned under the able leadership of Dr. Reese at the Philadelphia meeting in Sept., 1919, and again in St. Louis in spring of 1920. Papers of interest were read and discussed, and questions of much vital concern to the industry were fully considered, as, for example, the propaganda against American dyes, and the tariff protection so absolutely necessary to the unhampered growth of the industry. Furthermore the dye chemists learned to know one another better and to have a keener appreciation not only of the common problems, but of those individual to the other man.

Changed to a Division

As a section has only an informal organization, our aim was to change the section into the permanent form of Dye Division as soon as conditions warranted. Accordingly at the Philadelphia meeting Dr. Reese appointed as a committee to draw up by-laws; Dr. M. T. Bogert, chairman; Dr. W. H. Watkins, E. S. Chapin (with Dr. Reese and Mr. Shreve members ex-officia.' The by-laws were drawn up after a study of those of existing divisions, and were approved by the Council of the Society at St. Louis in spring of 1920. The chemists present at the St. Louis meeting then completed the formality of the organization of the Dye Division by adopting the by-laws, and by electing Dr. A. B. Davis as chairman of the division, W. J. Hale as vice-chairman, and R. Norris Shreve as secretary. Besides these three gentlemen the Executive Committee is composed of C. G. Derick and F. B. Holmes.

In naming the division, the question came up whether to use the word "Dye" or "Dye stuff." The choice fell upon the word "Dye" as being more truly American.

The secretary had been collecting over several years the names of chemists interested in dyes, and immediately after the formal organization all such chemists were invited to join the division and to participate in its activities and responsibilities. The various professional and trade publications have aided the secretary greatly in this publicity work. Every person interested in the chemistry of dyes in any of its various phases, whether manufacture or application, should be a member of this division. Prior membership in the American Chemical Society, the parent organization, is required.

Opportunities Offered

The Dye Division offers a medium for the presentation of their chemical observations, and for the discussion of their problems, to all connected with the dye industry in America. That this includes the important branch of the natural dyes and dye woods, as well as the synthetic coal-tar dyes, is of course fully understood. Yet the secretary wishes to emphasize the invitation to those chemists who are engaged with the natural dyes and dye woods, lest they be somewhat neglected, in face of the great publicity the synthetic dyes are receiving.

Due to the tremendous problems the American dye chemist has now before him, and to the unsettlement naturally accompanying the present developing state of the industry in America, the dye chemist has not had the opportunity to present before his fellow chemists papers of as deep a scientific interest as will come in the near future. This has been particularly true of the industrial dye chemists. The chemists working on dyes and intermediates in the Government laboratories have been free to publish all their results, and their researches have been fully given to their countrymen to their great and lasting benefit. In this connection it is the duty of every person interested in the dye industry, and this means practically everyone in the country, to see that his Congressman favors appropriation of liberal sums for support of the Government scientific laboratories, and the Color Laboratory of the Bureau of Chemistry, in particular. There is much scientific research work on dyes that can be carried out best in Government laboratories.

The Dye Division now has its permanent organization secured. It plans to be of help to the industry in every possible way. To do this, it needs the active support of all the chemists of the industry. In such an organization there is strength and promise for the future. American dye chemists must not aim at merely duplication work, but they must reach out into the unknown and improve and keep ahead of the times. To do this means chemical research and invention. The Dye Division must be an aid to such a development or it will fall short of its opportunities.

Importation of German Dyes Into United States

Textile Alliance, Inc., Has Been Official Agency for the Government

AS has been noted elsewhere in this issue, the production of dyestuffs in the United States progressed during the war to a stage where in place of the acute shortage existing shortly after the beginning of the conflict sufficient quantities were manufactured to keep all the textile mills running and to provide a surplus for export. Nevertheless it has been shown that domestic manufacture did not cover all of the products formerly imported from Germany.

In order to meet this deficiency, the War Trade Board Section of the Department of State began in October, 1919, to issue to dye consumers allocation certificates for the purpose of enabling them to import from Germany such quantities of vat dyes as would be necessary to satisfy their requirements for the six months period beginning October 15th of that year. The Textile Alliance, Inc., was designated as the agency through which the dyes should be imported.

This was extended in November of the same year to include non-vat dyes which could not be purchased in this country on sufficiently reasonable terms or in sufficient quantities.

In order to secure the dyestuffs called for by consumers under this ruling, Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry* was sent to France as special U. S. representative to negotiate for the receipt of vat dyes. He secured a portion of these through the Inter-Allied Reparation Commission and the remainder by direct option with the German Cartel. It will be recalled that under the terms of the peace treaty the Allied and Associated nations were entitled to a certain proportion of the existing stocks of dyestuffs in Germany and of the daily output of the German factories for a definite period of time. It was America's share of this provision which Dr. Herty secured at that time as part of the amounts needed to fill the consumers' requirements.

Scope of Alliance

Under the first allotment, the United States was entitled to 1,500 tons. Of this amount 300 tons were ordered and the remaining 1,200 tons of vat dyes and non-vat dyes were made available in June, 1920, as outlined in Bulletin No. 37 of the Textile Alliance, Inc. The Alliance also negotiated for the receipt of the greater part of the dyes secured by Dr. Herty through direct option with the Cartel.

The latest development in connection with the importation of German dyes occurred during the past month when the War Trade Board Section of the Department of State issued the following statement regarding the apportionment of existing stocks. This statement has been carried in a previous issue of *Textile World*, but in order to include in this Dye and Chemical Section for a matter of record the existing regulations regarding dyestuff importation, it is reprinted herewith:

"The United States Government, through the War Trade Board Section of the Department of State, has, in the interest of the people of the United States, authorized the Textile Alliance, Inc., of New York City, to undertake, *without profit to itself*, the following action in connection with Reparation dyes:

"(1) To purchase certain dyes, being the final apportionment of impounded stocks covered by inventories of German manufacturers as of August 30, September 5, 19, and 27, 1919, in order that certain dyes which are not manufactured in this country and which are included in these impounded stocks, might not be lost to the United States with detriment to American interests.

"(2) To purchase dyes from the present existing stocks manufactured by Germany between the dates of February 1, 1920, and June 30, 1920, both inclusive, in order that certain dyes which are not manufactured in this country and which are included in these stocks, might not be lost to the United States with detriment to American interests.

"(3) If found to be necessary and advisable to purchase such dyes as may be required and ordered through it by American consumers from future daily production of German manufacturers for the four and one-half year period commencing July 1, 1920.

"(4) The authority of the Textile Alliance, Inc., to resell to American consumers, the dyes acquired as above provided, is subject to strict provisions regarding selling price and manner of sale for the purpose of insuring fair and equal treatment to all consumers who may wish to avail themselves of the opportunity offered.

"The Government has decided to exercise its option upon German impounded stocks and has authorized the Textile Alliance, Inc., to purchase these stocks in the interest of the American consumer. Under existing regulations of the War Trade Board Section, no dyes from these stocks may be imported by the Textile Alliance, Inc., which are either manufactured here, or for which suitable substitutes are manufactured here on reasonable terms as to price, quality and production. No consumer will be allowed to receive more than a six months' supply of any dye at any one period from this source. Practically the same understanding is in effect regarding the daily production of the German factories from February 1 to July 30, 1920.

"Regarding the subject of future daily production, the Department of State has received information which would indicate that for some time to come the German factories will not be in a position to supply all expected requirements of the Allied and Associated countries and to fill Government orders emanating from these sources. If these indications are correct, it would appear that unless this Government indicated a desire to exercise its option on future daily production and should render available machinery which would make it possible for American consumers, if they so desire, to obtain colors from this source, the American consumer might not be able to get such German dyes as he required. The consumer should clearly understand that he is not obligated or even advised to place orders through the machinery made available by the Government. If he believes that German dyes may be obtained from unofficial sources, he may, subject to the then existing import regulations, either order such dyes as he needs direct from the German manufacturer or through such agent or agency as he may designate.

"If the consumer, however, cannot obtain or believes he cannot obtain dyes by other means, the Government can exercise its option on the subsequent daily production of the German factories and the Textile Alliance, Inc., can transmit his orders for purchase from official sources."

Services Performed

The activity of the Textile Alliance, Inc., in connection with the importation of German dyes and the procedure to be followed were outlined in Bulletin No. 35 issued by that organization. The important paragraphs of that bulletin were as follows:

"The War Trade Board Section of the Department of State has designated the Textile Alliance, Inc., as the sole official agency to import on behalf of consumers such portion of the total allocation of dyes as have been made available as the result of those negotiations.

"Accordingly, the Textile Alliance, Inc., will perform the following services in connection with the importation of vat dyes from the official sources referred to above.

"(a) To accept from the consumer vat dye certificates issued by the War Trade Board for vat dyes in amounts not exceeding the amounts specified in such certificates.

"(b) To file all applications for licenses for vat dyes secured through this source and covered by such allocation certificates as have been endorsed to the Textile Alliance, Inc.

"(c) To attend to all the details connected with the acquisition of and terms of payment for the above mentioned vat dyes and their shipment to the Textile Alliance, Inc., and to arrange for distribution to the respective consumers who have ordered them through this source.

Procedure

"(a) The consumer endorses and delivers allocation certificate to the Textile Alliance, Inc., at the same time executing and forwarding the order (Form No. D-1) stating the amount of dyes (not exceeding, however, the amount allocated to him) which he desires to purchase under this agreement.

"(b) On receipt of the above an application for an import license will be filed by the Textile Alliance, Inc., with the War Trade Board.

"(c) At the same time a pro forma invoice will be rendered to the consumer, same to be based on figures available at that time representing approximately the cost (including all charges incidental to complete delivery on a c. i. f. New York basis) of the dyes so ordered. A check (New York funds) in favor of the Textile Alliance, Inc., for the amount of the pro forma invoice must be sent to this office immediately. On receipt of same the order will be cabled to the representative of the Textile Alliance, Inc., in Paris, who will proceed with the purchase.

"(d) In the event that it should prove impossible to secure the entire amount of the various dyes applied for it is understood that the Textile Alliance, Inc., shall be entitled to procure for and deliver to each certificate holder his pro rata share of the total amount obtainable.

"(e) On arrival of the merchandise invoice will be rendered showing the charges so far as then ascertained and settlement must be made at that time subject to correction.

Textile Alliance, Inc., Charges

"The purchase, importation and distribution of all vat dyes acquired under the above mentioned plan *will be effected at cost and without profit to the Textile Alliance, Inc.* To meet the estimated expenses of this organization in conducting this work a charge of 15% will be made upon the amount of each purchase, computed upon the delivered cost including duty. *Any unexpended balance of the funds remitted for the expenses of the Textile Alliance, Inc., will be returned pro rata.*

Liability

"All purchasers ordering vat dyes under this plan must indemnify and agree to hold harmless the Textile Alliance, Inc., and its officers, agents and employes from any and all claims or liabilities arising in connection with any importations, sales or deliveries of the vat dyes covered by this bulletin.

"Importations after arrival will be at owners' risk and expense."

Difficulties Encountered

In discharging its duties, the Textile Alliance, Inc., has met with many obstacles in the form of floods, coal shortage, and strikes in Germany. Even when the dye stuffs concerned finally did reach Holland, they were held up in that country for several months by a longshoremen's strike. Finally, however, these obstacles were overcome, and it is understood that the bulk of the dyestuffs ordered by consumers have been received.

The Textile Alliance, Inc., through its activities in bringing in dyestuffs not manufactured in this country but needed by consumers, has been an important factor in domestic dyestuff circles.

AMERICAN POTASH SUPPLY

New Plants Being Built in United States for Its Production

Several large plants for the manufacture of potash in the United States are nearing completion according to a report made at the recent annual meeting of the U. S. Potash Producers' Association recently held in Chicago, and noted in a recent number of the *Journal of Industrial and Engineering Chemistry*. It is expected that the output of potash in this year will double that of 1920.

Before the European War almost all the potash used in this country was imported from Germany, where there are enormous deposits of the valuable mineral which is extensively employed as a fertilizer and also in the arts.

By encouraging the production of potash in this country Americans will no longer be under the domination of the German syndicates. A recent report of the United States Geological Survey also shows that France is able now to sell considerable quantities of the element, for there are extensive deposits of it in her regained Alsace.